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NAS PENSACOLA

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FINAL RECORD OF DECISIO
OPERABLE UNIT 4
NAS PENSACOLA
PENSACOLA, FLORIDA

SOUTHNAVFACENGCOM
Contract Number:
N62467-89-D-0318
CTO-083

Prepared for:

Comprehensive Long-Term **Environmental** Action Navy
(CLEAN)
Naval Air **Station**
Pensacola, Florida

Prepared by:

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List of Abbreviations

μg/kg	micrograms per kilogram
μg/L	micrograms per liter
ARAR	applicable or relevant and appropriate requirement
BAT	best achievable technology
BCT	best conventional pollution control technology
BEQ	benzo(a)pyrene equivalent
bgs	below ground surface
BMP	best management practice
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response and Compensation Act
CFR	Code of Federal Regulation
CGL	Cleanup goal for leaching
CG	Cleanup goal
CDI	chronic daily intake
CLP	Contract Laboratory Program
COC	contaminant of concern
COPC	contaminant of potential concern
CPSS	chemical present in site sample
CT	central tendency
ECAO	Environmental Criteria and Assessment Office
E&E	Ecology and Environment, Inc.
ERA	ecological risk assessment
EP	extraction procedure
EPC	exposure point concentration
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FFA	Federal Facilities Agreement
FS	Feasibility Study
FGGC	Florida Groundwater Guidance Concentration
FI/FC	fraction ingested or contacted
FOTW	federally owned treatment work
FPDWS	Florida Primary Drinking Water Standard
FSWQS	Florida Surface Water Quality Standard

HEAST	Health Effects Assessment Summary
HHRA	human health risk assessment
HI	hazard index
IAS	Initial Assessment Study
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LTTD	low temperature thermal destruction
LUCAP	land-use control agreement
LWA	lifetime weighted average
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MSMA	monosodium methanarsonate
NA	not applicable
NAS	Naval Air Station
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NPDES	National Pollutant Discharge Elimination System
NPL	National Contingency Plan
O&M	operation & maintenance
OU	operable unit
OSWER	Office of Solid Waste and Emergency Response
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRG	preliminary remediation goal
RAB	Restoration Advisory Board
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RC	reference concentration
RD/RA	remedial design/remedial action
RFA	RCRA Facility Assessment
RfD	reference dose

RFI	RCRA Facility Investigation
RG	remedial goal
RGO	remedial goal option
RHC	risk/hazard criterion
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	record of decision
SCTL	soil cleanup target level
SEGS	Southeastern Geological Society
SF	slope factor
sf	square feet
SMCL	secondary MCL
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TBC	tu be considered
TRC	Technical Review Committee
TRPH	total recoverable petroleum hydrocarbon
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

DECLARATION OF THE RECORD OF DECISION

Site Name and Location

Operable Unit 4, Site 15, Pesticide Rinsate Disposal Area
Naval Air Station Pensacola
Pensacola, Florida

Statement of Purpose

This decision document (Record of Decision), presents the selected remedy for Operable Unit 4 at the Naval Air Station Pensacola, Pensacola, Florida. The remedy was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. § 9601 et *seq.*, and to the extent practicable, the National Contingency Plan (NCP), 40 Code of Federal Regulations Part 300.

This decision is based on the administrative record for Operable Unit 4 at the Naval Air Station Pensacola.

The United States Environmental Protection Agency and the Florida Department of Environmental Protection concur with the selected remedy.

Assessment of the Operable Unit

Actual or threatened releases of hazardous substances from Operable Unit 4, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health or the environment.

Description of the Selected Remedy

This action is the first and final action planned for the operable unit. This alternative calls for the design and implementation of response measures to protect human health and the environment. The action addresses the sources of contamination as well as soil and groundwater contamination.

The major components of the remedy are:

- Institutional controls imposed in accordance with the Land Use Control Assurance Pian (LUCAP) to restrict use of groundwater from the surficial zone of the Sand-and-Gravel Aquifer within 300 feet of the site.

- Review of the institutional controls and certification that they should remain in place or be modified to reflect changing site conditions.

- Groundwater monitoring to ensure that the chemicals of concern (COCs) are not moving offsite.

- A review during which the Navy would determine whether groundwater performance standards continue to be appropriate.

- The groundwater monitoring program will continue until the alternative has achieved continued attainment of performance standards and remains protective of human health and the environment.

The major components of the soil remedy are:

- Removal of excess risk from the dermal and ingestion pathways for contaminated soil (by removing contaminated soil above industrial goals through a removal action).

- Implementation of institutional controls through the LUCAP restricting site use to industrial.

- Review of the institutional controls and certification that they should remain in place or be modified to reflect changing site conditions.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite, it will be reviewed within five years after it commences to evaluate that it continues to adequately protect human health and the environment.

Randal L Bahr — 30 Nov 99

Captain Randal L. Bahr, NAS Pensacola — Date

1.0 SITE LOCATION AND DESCRIPTION

Operable Unit (OU) 4, Site 15, is in the northern portion of Naval Air Station (NAS) Pensacola in Pensacola, Florida as shown on Figure 1-1. The site, which includes the golf course maintenance facilities, is accessible from the west by an unpaved road that enters the site from within NAS Pensacola. Land surface across the site is generally level and unpaved, except for small paved areas used for equipment washdown. These areas, shown on the site map in Figure 1-2 include three concrete wash-down pads, each covering approximately 250 square feet or less, and two asphalt pads covering less than 50 square feet+ Six buildings and one underground storage tank (UST) are or were in the immediate site vicinity:

- Building 2640, large equipment (tractor/mower) storage
- Building 747, office space
- Building 3447, equipment maintenance and storage
- Buildings 1851 and 1776, equipment storage
- Building 3586, controlled storage of bulk fertilizer, pesticides, and herbicides
- UST north of Building 3586 (Removed in 1993)

Surroundings

The site is bordered by the NAS Pensacola golf course on its southern and western sides, Bayou Grande approximately 600 feet to the north, and a tidal pond to the east. NAS Pensacola is an active U.S. Naval facility and access is controlled by the military. Bayou Grande has been classified by the Florida Department of Environmental Protection as a Class III water body, indicating its use for recreation and maintaining a well-balanced fish and wildlife population. The tidal pond is a small tributary source to the Bayou Grande.

Natural Resources

No natural resources are harvested or mined at this site.

RECORD OF DECISION
SITE 15
NAS PENSACOLA

FIGURE 1-1
SITE LOCATION MAP

DWG DATE: 11/18/98 | DWG NAME: 0083B001

RECORD OF DECISION
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FIGURE 1-2
SITE MAP

DWG DATE: 11/18/98 | DWG NAME: 0083B002

Surface Water

Sandy soils typify the **NAS** Pensacola area, Consequently, most rainfall directly infiltrates into the subsurface, resulting in few natural streams. Streams on base are generally man-made and channelized. Numerous natural wetlands occur in low-lying areas.

Stratigraphy and Hydrogeology

Stratigraphy beneath the Florida Panhandle generally consists of Quaternary marine terrace and fluvial deposits, underlain by a thick sequence of interlayered fine-grained clastic deposits and Tertiary-age carbonate strata (Southeastern Geological Society [SEGS], 1986). Three main regional hydrogeologic units have been described within this stratigraphic column (in descending order): the surficial/Sand-and-Gravel Aquifer, the Intermediate System, and the Floridian **Aquifer** system.

As discussed in the Remedial Investigation (RI) Report, groundwater is encountered 10 to 15 feet below ground surface (bgs) across most of the site, except along the bayou and the tidal pond. Groundwater flows generally to the north-northwest along Bayou Grande, and to the north-northeast along the tidal pond. In general, the potentiometric surface mimics topography. There has been little to no variation in the surface configuration during multiple sampling events, although water levels appear to vary seasonally.

The surficial aquifer beneath the site is 30 to 40 feet thick, consisting of a homogeneous fine- to medium-grained sand. Most monitoring wells in the unit are screened at or near the water table, with terminal depths ranging from 15 to **20** feet bgs. Two wells (GR-39 and GR-40) were completed to the intermediate confining unit. The surficial aquifer is not used as a potable drinking water source; given the availability of alternate superior quality water supplies, it is unlikely that the surficial aquifer will be used as a potable source in the future. In addition, groundwater from **NAS** Pensacola background wells exceeds primary and secondary standards, indicating that it may be classified as a groundwater of poor quality. .However, the aquifer is considered a G-II aquifer (i.e., a potential future source of drinking water).

2.0 SITE HISTORY & ENFORCEMENT ACTIVITIES

2.1 General Site History

In December 1989, the base was placed on the United States Environmental Protection Agency's **(USEPA)** National Priorities List (NPL). The Federal Facilities **Agreement (FFA),** signed in October 1990, outlined the regulatory path to be followed at **NAS** Pensacola. **NAS** Pensacola must not only complete the regulatory obligations of its NPL listing, it also must satisfy the ongoing requirements of an environmental permit issued in 1988. **A** permit is an authorizing document issued by an approved Florida agency or USEPA to implement the requirements of an environmental regulation. This permit addresses treatment, storage, and disposal of hazardous materials and waste, as well as the investigation and remediation of any releases of hazardous waste and/or constituents from solid waste management units (SWMUs) at **NAS** Pensacola. The Resource Conservation and Recovery Act (RCRA) governs ongoing use of hazardous materials and the operating permit rules. RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigations and actions are coordinated through the **FFA,** streamlining the cleanup process.

2.2 Site-Specific History

From 1963 to the present, fertilizer? pesticide, and herbicide materials €or application at **NAS** Pensacola's golf course have been stored and mixed at the golf course maintenance facility. **Application equipment** is also rinsed at the facility's wash-down pads. The original Site **15** area identified in previous investigations included Building **2692,** the pesticide storage area just off Building 2692's northeastern comer, and the asphalt wash-down pad northwest of Building 2640.

Commercial application equipment such as tractors, sprayer tanks, spreaders, etc., are currently used in routine golf course maintenance. Equipment is currently cleaned at a wash stand, which collects the rinsate for re-use. Before construction of the wash stand, these rinsates, reported to contain organic phosphates, chlorinated hydrocarbons, carbaryl, and carbamates, had directly infiltrated the sandy soil (G&M, 1984). Currently, tractors and large mowers are rinsed on the concrete wash-down pads northeast of Building 2692 and northwest of Building 3447. Pollution prevention practices and procedures have minimized further releases of rinsate to the environment.

Building 3586, approximately 375 feet east of Building 2692, has been used to rinse equipment and store and handle herbicides and pesticides since its 1979 construction. Previously, a sink outside the building and a drain in a concrete pad north of the building collected pesticide/herbicide residue wastes and discharged them to a UST. The contents were periodically pumped out bv a contracted agent before the tank's removal in 1993. During the removal, the tank's contents were placed in an area north of the dirt road. Wash stands are currently used for equipment rinsing to collect the rinsate for re-use.

In summary, based on site history, Site 15 areas where releases potentially occurred are:

- Pesticide/drum storage areas at Building 2692's former location
- Four equipment rinsate/pesticide handling areas:
  - the asphalt pad northwest of Building 2640
  - the concrete wash-down pad and drainage area northwest of Building 2692
  - the wash-down and drainage area at the northwest corner of Building 3447
  - the pesticide handling area adjacent to Building 3586's west side
- Equipment storage Building 2640
- Holding tank contents disposal area north of the dirt road

Currently, waste minimization procedures are in place at handling areas to eliminate the potential for any contaminant releases to the environment.

2.3 Chronology of Events and Previous Investigations

The following chronology of events and previous investigations at Site 15 provides a basis for understanding the history and focus of the remedial investigation/feasibility study (RI/FS).

1983 — Initial Assessment Study

The Initial Assessment Study (IAS) report prepared by the Naval Energy and Environmental Support Activity (NEESA) identified sites potentially posing a threat to human health or the environment due to contamination from past hazardous materials operations. Historical records, aerial photographs, field inspections, and personnel interviews were used to identify 29 potentially contaminated sites at NAS Pensacoia. One of those identified for evaluation by this study was Site 15. According to the IAS report conclusions, discarded pesticide rinsates were not sufficiently concentrated to threaten human health or the environment. Therefore, further study was not recommended (NEESA, 1983). Since environmental sampling and laboratory analyses were not performed, the information required to thoroughly assess the magnitude and extent of residual contamination was not available.

Confirmation Study

In 1984, Geraghty and Miller (G&M) was retained by the Navy to perform a Confirmation Study at NAS Pensacola. It consisted of two parts: a Verification Study in 1984 and a Characterization Study in 1986.

1984 — *Verification* Study

The 1984 Verification Study examined the asphalt wash-down pad and the pesticide storage area adjacent to Building 2692. At three soil borings completed to 2 feet below land surface (bls), samples were collected and analyzed for arsenic and pesticides. The analytical results indicated arsenic and organic pesticides in site soil, with concentrations consistently decreasing with depth. Detected total arsenic concentrations ranged from 1.6 parts per million (ppm) to 31 ppm; total pesticides ranged from 0.02 ppm tu 23.4 ppm. Appendix B, Table B-1 of the RI report? presents the analytical results. Installation of shallow monitoring wells and additional soil borings was recommended to assess groundwater quality and define the extent of soil impact (G&M, 1984).

1986 – Characterization Study

Two shallow monitoring wells (GM-59 and GM-60) and six additional soil borings approximately 2 feet deep were completed during the 1986 Characterization Study (G&M, 1986). Groundwater sampies were analyzed for pesticides, polychlorinated biphenyls (PCBs), and arsenic; soil was analyzed for arsenic only using the extraction procedure (EP) toxicity methodology. The only parameter detected in groundwater was arsenic (0.153 ppm) in the sample from well GM-59. Two of the concentrations exceeded the Florida Primary Drinking Water Standards (FPDWS) of 50 micrograms per liter (μg/L). Arsenic was also detected in several soil samples. Tables B-2 and B-3 in Appendix B of the RI report present the analytical results. A program was recommended to delineate the areal extent of soil contamination, with soil removal tu appropriate levels along with monitoring well re-sampling and analysis for arsenic (G&M, 1986).

1991 – *Contamination Assessment/Remedial Activities Investigation*

As part of the Navy's Installation Restoration Program (IRP), Ecology and Environment, Inc. (E&E) performed Phase I of a Contamination Assessment/Remedial Activities Investigation at Site 15. The objective was to identify principal areas and primary contaminants of concern and to recommend any subsequent investigations.

Fieldwork included site reconnaissance, surface emission surveys, particulate air screening, utilities surveys, collection and laboratory analyses of soil and groundwater samples, and a hydrologic assessment. Most soil and temporary groundwater well samples were analyzed only at a screening level. Samples from GM-59 and GM-60 were analyzed using Contract Laboratory Program (CLP) level analyses. This analytical approach focused additional investigative efforts on areas with significant screening detections. Additionally, groundwater samples were often turbid and most were analyzed unfiltered, a method associated with high metal concentrations.

Investigative results indicated the potential presence of metals (particularly arsenic), total recoverable Petroleum hydrocarbons (TRPHs), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and pesticides in site soil. Low metals concentrations (Particularly arsenic) and dieldrin/4,4-DDE were detected in the groundwater samples. Tables B-4, B-5, and B-6 in Appendix B of the RI report present the analytical results. Limited additional assessment was recommended for Site 15. Complete results are presented in an Interim Data Report for the site (E&E, 1991).

Building *3586 UST* Removal

The UST south of Building 3586 was removed in 1993. The contents of the rinsate holding tank and associated soil were spread across a nearby portion of the golf course, approximately 200 feet north-northwest of Building 3447 (Figure 1-2, Site Map). No analytical results or other specific information were available from this removal activity.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Throughout the site's history, the community has been kept abreast of activities in accordance with CERCLA Sections 113(k)(2)(B)(i-v) and 117. In January 1989, a Technical Review Committee (TRC) was formed to review recommendations for investigation and remediation efforts at NAS Pensacola and monitor its progress. The TRC was made up of representatives of the Navy, USEPA, Florida Department of Environmental Regulation (FDER) (now the Florida Department of Environmental Protection [FDEP]), and the local community. In addition, a mailing list of interested community members and organizations was established and maintained by the NAS Pensacola Public Affairs Office. In July 1995, a Restoration Advisory Board (RAB) was established as a forum for communication between the community and decision-makers. The RAB absorbed the TRC and added members from the community and local organizations. RAB members work together to monitor progress of the investigation and to review remediation activities and recommendations at NAS Pensacola. RAB meetings are held regularly, advertised, and are open to the public.

Site-related documents were made available to the public in the administrative record at information repositories maintained at the NAS Pensacola Library and the John C. Pace Library of the University of West Florida.

After finalizing the RI and Feasibility Study (FS) reports, the preferred alternative for Site 15 was presented in the Proposed Remedial Action Plan, also called the *Proposed Plan*. Everyone on the NAS Pensacola mailing list was sent a copy of the proposed plan. The notice of availability of the Proposed Plan, RI, and FS reports was published in the *Pensacola News Journal* on August 21, 1999. A public-comment period was held from August 23 to October 6, 1999, to encourage public participation in the remedy selection. In addition, the opportunity for a public meeting was provided. Responses to comments received during the comment period are in Appendix B.

4.0 SCOPE AND ROLE OF THE OPERABLE UNIT

The selected remedies for OU 4 (Site 15) have been selected to reduce risks to human health and the environment. Two remedial options have been selected fur Site 15, one for groundwater and one for soil. The two technologies are independent of each other, because the remedial investigation has shown that there is no correlation between contamination in surface soil and groundwater.

The selected remedies will address conditions posing risk to human health and the environment, including:

- Contaminated groundwater may impact drinking water supplies or nearby ecological receptors in Bayou Grande or the tidal pond.
- Site workers may be exposed to contaminated surface soil.

Pathways of exposure include:

- Ingestion and inhalation of contaminated groundwater.
- Aquatic exposure of ecological receptors from groundwater migrating to surface water.
- Incidental ingestion and dermal exposure to contaminated surface soil.

The major components of the groundwater remedy are:

- Institutional controls imposed in accordance with the Land Use Control Assurance Plan (LUCAP) to restrict use of groundwater from the surficial zone of the Sand-and-Gravel Aquifer within 300 feet of the site.

- Review of the institutional controls and certification that they should remain in place or be modified to reflect changing site conditions.

- Groundwater monitoring tu ensure that the chemicals of concern (COCs) are not moving offsite.

- A review during which the Navy would determine whether groundwater performance standards continue to be appropriate.

- Groundwater monitoring will be performed in accordance with the Groundwater Monitoring Plan. When performance standards (remedial goals) are attained during one of these events, the monitoring interval will be modified. After two consecutive sampling events show attainment of performance standards and concurrence with USEPA and FDEP is received, the monitoring program will cease.

The major components of the soil remedy are:

- Removal of excess risk from the dermal and ingestion pathways for contaminated soil (by removing contaminated soil above industrial goals through a removal action).

- Implementation of institutional controls through the LUCAP restricting site use to industrial.

- Review of the institutional controls and certification that **they** should remain **in** place or be modified tu reflect changing site conditions.

These remedies address the first and final cleanup action planned fur Site 15. Because surface soil has been contaminated with arsenic and dieldrin at Site 15, the remedy has been selected to **prevent** future unacceptable **exposure** to contaminated soil. Groundwater in the upper surficial **aquifer** below the site has been contaminated with arsenic; however, subsurface soil sampling indicated no significant source area that could impact groundwater. The water-bearing zone is **affected** but contamination **is** not affecting the public drinking water supply. The groundwater remedy has been selected to prevent unacceptable current or future **exposure** to contaminated groundwater.

This is the only Record of Decision (ROD) contemplated for Site 15. Operable Unit 4 (Site 15) is one of 13 OUs within **NAS** Pensacola. The purpose of each OU is defined in the FY *1999* Site Management Plan (SOUTHNAVFACENGCOM, 1998) for **NAS** Pensacola, available in the Administrative Record.

5.0 SITE CHARACTERISTICS

This section of the ROD presents an overview of the nature and extent of contamination at Site 15 with respect to known or suspected sources of contamination, types of contamination, and affected media. Known or potential contaminant migration routes are also discussed.

5.1 Suspected Sources of Contamination

Based on site history, Site 15 areas where releases potentially occurred are:

- Pesticide/drum storage areas at Building 2692's former location
- Four equipment rinsate/pesticide handling areas:
  - the asphalt pad northwest of Building 2640
  - the concrete wash-down pad and drainage area northwest of Building 2692
  - the wash-down and drainage area at the northwest corner of Building 3447
  - the pesticide handling area adjacent to Building 3586's west side
- Equipment storage Building 2640
- Holding tank contents disposal area north of the dirt road

Currently, waste minimization procedures are in place at handling areas to eliminate the potential for additional releases to the environment.

5.2 Nature and Extent

This discussion is based primarily on the results presented in the RI report. To determine the nature and extent of contamination? samples were collected and compared to Preliminary Remediation Goals (PRGs) for soil and groundwater. The PRGs are based on the following regulatory guidance:

Surface and Subsurface Soil PRGs

- RBCs for residential surface soil and soil screening levels (SSLs) transfer scenario from soil to groundwater for subsurface soil (USEPA, 1996a).

- Selected soil cleanup goals (CGs) residential scenario and leaching scenario (CGLs) (FDEP, 1995, [with 1996 and 1997 revisions]).

- USEPA, Office of Solid Waste and Emergency Response (OSWER) draft revised *Interim Soil* Lead Guidance (USEPA, 1994a).

- Title 40 Code of Federal Regulations (CFR) Part 761.125 Requirements for PCB Spill Cleanup (USEPA, 1988).

- USEPA, OSWER Soil Screening Guidance (USEPA, 1994b).

Groundwater *PRGs*

- FPDWS, Florida Secondary Drinking Water Standards (FSDWS), and the Florida Surface Water Quality Standards (FSWQS); (FDEP, June 2, 1994).

- Florida Groundwater Guidance Concentrations (FGGC) (FDEP, June 2, 1994).

- USEPA Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) (USEPA 1996b).

5.2.1 Remedial Investigation Assessment

The results of the multi-phase RI follow:

Soil Contamination

Several inorganic and organic parameters exceeding PRGs were detected in site soil samples. However, based on the detections' magnitude and frequency, arsenic and dieldrin are the primary parameters of concern in soil. Arsenic was detected across the site's full extent due to the handling of various arsenic-based herbicides and pesticides, such as the common herbicide monosodium methanarsonate (MSMA). As shown in Figure 5-1, the two areas of greatest surface soil arsenic concentration are the asphalt pad northwest of Building 2640 and the concrete pad west-northwest of Building 3586. However, soil was contaminated at isolated locations throughout Site 15 and north of the road in the old disposal area+

Dieldrin was detected primarily across the site's western-southwestern portion, where storage Building 2692 and equipment storage shed 2640 are located. Dieldrin concentrations exceeding 50 ppb were limited to the area northwest and east of Building 2640's asphalt wash-down pad and beneath the building and at boring 15S50 north of Building 3447. As shown in Figure 5-2, the areas of greatest surface soil dieldrin concentration are immediately around the asphalt pad.

Subsurface soil samples exceeded the USEPA SSL for dieldrin (1 ppb) in 13 sample locations. However, only one sample location at the asphalt pad (15S04) exceeded the FDEP CGL (20 ppb) at a depth of 5 feet. Arsenic in one subsurface sample (15S13) exceeded its USEPA SSL of 15 ppm at a depth of 10 feet (16.2 ppm), which is less than the FDEP CGL (29 ppm). These two isolated occurrences do not reflect subsurface soil as a source of potential groundwater contamination.

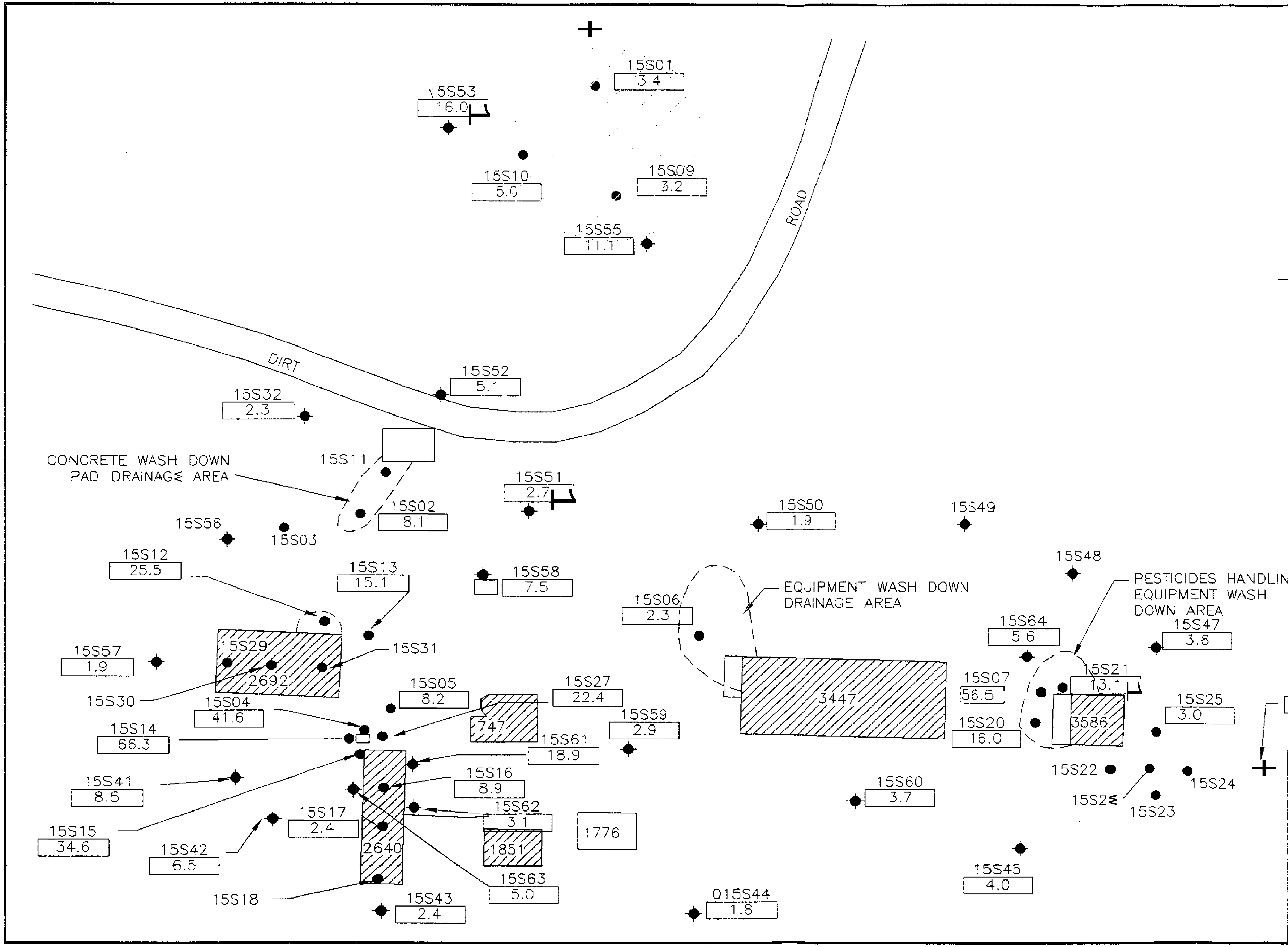

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FIGURE 5–1
ARSENIC DETECTIONS IN SITE 15 SURFACE SOIL EXCEEDING PRGs AND RCs

DWG DATE: 11/18/98 | DWG NAME: 0083B003

FIGURE 5–2
DIELDRIN DETECTIONS IN SITE 15 SURFACE SOIL EXCEEDING PRGs

Groundwater Contamination

Arsenic commonly exceeded its PRG and RC; it was the primary parameter of interest detected in shallow groundwater. Arsenic was not detected in intermediate depth groundwater samples above the FPDWS, indicating that arsenic has not migrated downward.

Three areas of PRG exceedances in groundwater are shown in Figure 5-3: the area immediately around the asphalt pad at Building 2640's northwestern corner, an area north of Building 2692, and an area north of Building 3586. The areas of the highest arsenic concentrations in shallow groundwater are north of Buildings 2692 and 3586, downgradient of areas where soil arsenic concentrations exceed PRGs. The groundwater sampling results from the most downgradient monitoring wells, 15GS68 through 15GS71 adjacent to Bayou Grande and the tidal pond, indicate that arsenic concentrations above PRGs do not extend beyond the golf course to the north. Rather, given the distribution and magnitude, arsenic concentrations in groundwater above PRGs are limited to the site and immediately downgradient areas. One potential downgradient area east of the site will be monitored during remedial design/remedial action (RD/RA).

Site 15 groundwater ultimately discharges into Bayou Grande and the Tidal pond, which are being assessed in the Site 40 and 41 RIs.

FIGURE 5-3
MAXIMUM ARSENIC CONCENTRATIONS DETECTED IN GROUNDWATER SAMPLES DURING ALL SAMPLING PHASES

6.0 SUMMARY OF SITE RISK

A baseline risk assessment (BRA) for Site 15 included a human health risk assessment (HHRA) and ecological risk assessment (ERA) as part of the RI report (EnSafe, December 1997). The BRA, which was based an contaminated environmental site media as identified in the RI, was conducted to assess the resulting impact to human health and the environment. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health or the environment.

6.1 Human Health Risk Assessment

6.1.1 Chemicals of Potential Concern

Contaminants detected at Site 15 were screened against available federal and State of Florida cleanup criteria, soil and groundwater standards, and reference concentrations to develop a list or group of chemicals referred to as chemicals of potential concern (COPCs). COPCs are selected after comparison to screening concentrations (risk-based, leachability-based, and reference), intrinsic toxicological properties, persistence, fate and transport characteristics, and cross-media transfer potential. Any COPC is considered a chemical of concern (COC) if it is carried through the risk assessment process and found to contribute to a pathway that exceeds a 10^{-6} risk or hazard index (HI) greater than 1 for any of the exposure scenarios evaluated in this risk assessment and has an incremental lifetime cancer risk (ILCR) greater than 10^{-6} or hazard quotient (HQ) greater than 0.1. Tables 6-1 and 6-2 summarize the surface soil and groundwater COPCs. Bayou Grande and NAS Pensacola wetlands surface water and sediment will be further evaluated during the Site 40 and 41 RIs.

Essential elements may be screened out of a risk assessment if concentrations detected are not associated with adverse health effects. 'Therefore, the following nutrients were eliminated: calcium, iron, magnesium, potassium, and sodium.

Table 6-1
Surface Soil COPCs

COPC	Units	Frequency of Detection	Range of Concentration	Average Concentration
Aldrin	μg/kg	2/28	2.4 — 50	26.2
Alpha-Chlordane	μg/kg	19/28	0.58 — 3,100	19.7
Arsenic	mg/kg	51/53	0.29 — 66.3	8.78
BEQ	μg/kg	16/33	8.89 — 1,615	154
Dieldrin	μg/kg	25/28	0.52 — 3,000	159
gamma-Chlordane	μg/kg	19/28	0.54 — 2,000	153
Heptachlor Epoxide	μg/kg	7/28	1.8 — 180	30.7
Manganese	mg/kg	53/53	7 — 215	71

Notes:
COPC = chemical of potential concern
μg/kg = microgram per kilogram or part per billion
mg/kg = milligram per kilogram or part per million

Table 6-2
Groundwater COPCs

COPC	Frequency of Detection	Range of Concentration	Average Concentration
Aluminum	4/4	703 — 3,900	1,645
Arochlor 1260	1/12	0.32 — 0.32	0.32
Arsenic	51/53	0.29 — 66.3	8.78
Chloroform	1/12	0.8 — 0.8	0.8
Chromium	2/12	5.4 — 1,060	532.15
Dieldrin	6/12	0.0023 — 0.033	0.0151
Heptachlor Epoxide	3/12	0.0015 — 0.005	0.0028
Manganese	10/12	6.8 — 50.9	13.43

Notes:
COPC = chemical of potential concern
All results are in micrograms per liter (μg/L) or parts per billion (ppb).

The risk and hazard posed by Site 15 contaminants were assessed for current and hypothetical future site workers and the hypothetical future site residents under reasonable maximum exposure (RME) assumptions. For surface sail?the incidental ingestion and dermal contact pathways were assessed. For groundwater, the ingestion pathway was evaluated. The following discussion summarizes the Site 15 HHRA results.

6.1.2 Exposure Assessment

Whether a chemical is actually a concern to human health depends on the likelihood of exposure, i.e., whether the exposure pathway is currently complete or could be in the future. A complete exposure pathway is defined as a sequence of events leading to contact with a chemical. If all four elements are present, the pathway is considered complete:

- Source and mechanism of release
- Transport medium (e.g., surface water, air) and migration mechanisms through the medium
- Presence or potential presence of a receptor at the exposure point
- Exposure route (ingestion, inhalation, dermal absorption)

All potential exposure pathways that could connect chemical sources at Site 15 with potential receptors were evaluated. All possible pathways were first hypothesized and evaluated for completeness using the above criteria. Current pathways represent exposure pathways that could exist under current conditions, while future pathways represent exposure pathways that could exist in the future, if current exposure conditions change.

Exposure Setting

Site 15 is in the golf course maintenance facility at NAS Pensacola where equipment, fertilizer, and pesticides are handled and stored. This site is currently used to manage and store equipment, fertilizer, and pesticides for application at the golf course. Future site use is not expected to change.

Potentially Exposed *Population*

Potentially **exposed** populations are current and future site workers. Hypothetical future site residents were also evaluated as a potentially exposed population in the risk assessment, even though future site use is not expected to change. During the BRA, it was assumed that all surface soil locations were unpaved, workers were continuously exposed to surface soil sample locations, and groundwater was used as a potable source. Current site worker **exposure** would be less than that assumed for the hypothetical future site workers because of their limited soil contact and the fact that groundwater is not currently used onsite as potable or process water.

6.1.3 Quantification of Exposure

This section describes the models, equations, and intake model variables used tu quantify COPC doses or intakes for **the** surface soil and groundwater exposure pathways. The models are designed to estimate route- and medium-specific factors, which are multiplied by the exposure point concentration (EPC) tu estimate chronic daily doses. When applied to the EPC, the intake model variables generally reflect 50th or 95th percentile values which ensure that the estimated intakes represent the reasonable maximum exposure (EWE), which is considered 95th percentile. Formulas are derived from RAGS, Part **A,** unless otherwise indicated. Table 6-3 lists RME intake model variables used to compute chronic daily intake (CDI) for potential receptors exposed to surface soil and/or groundwater contaminants. Central tendency (CT) model variables are presented in Table 6-4.

Table *6 3*
RME **Parameters Used to Estimate CDI**

Pathway Parameters	Resident Adult	Resident Child	Adult Worker	Trespassing Child (age 7-16)	Units
Ing on Rate (l)	100[a]	200[a]	50[a]	100[a]	mg/day
Ingestion Rate (water)	2	1	1	NA	L/day
Exposure Frequency	350[b]	350[b]	250[b]	52[f]	days/year
Exposure Duration	24'	6[c]	25[c]	10[g]	years
Dermal Contact Area	4,100[a]	2,900[a]	4,100[a]	4,100[a]	cm^2
Skin Adherence Factor	1	1	1	1	mg/cm^2
Absorption Factor	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	unitless
Oral Absorption Efficiency	0.8 (VOCs) **0.5** (other organic chemicals) **0.2** (inorganics)	0.8 (VOCs) 0.5 (other organic chemicals) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic **chemicals)** 0.*2* (inorganics)	0.8 (VOCs) 0.5 (other organic **chemicals)** ***0.2*** (inorganics)	unitless
Conversion Factor	1E-6	1E-6	1E-6	1E-6	kg/mg
Body Weight	70[a]	15[a]	70[a]	45[a]	kg
Averaging Time, Noncancer	8,760[d]	2,190[d]	9,125[d]	3,650[d]	days
Averaging Time, Cancer	25,550[e]	25,550[e]	25,550[e]	25,550[e]	days

Notes:

a = **USEPA** (1989a) Risk **Assessment** Guidance *for Superfund Vol. I, Human* Health *Evaluation* Manual *(Part* **A).**

b = **USEPA** (1991a) **Risk** *Assessment Guidance for Superfund Vol.* **I:** Human *Health Evaluation Manual* Supplemental Guidance, *Standard* Default *Exposure Factors, Interim Final,* OSWER Directive: 9285.6-03.EPA/600/8-89/043.

c = **USEPA** (1991b), **Risk** *Assessment* Guidance *for* Superfund: *Vol. I* — Human *Health* Evaluation *Manual (Part B,* **Development** of Risk-Based *Preliminary Remediation* Goals), USWER Directive **9285**.7-01B.

d = Calculated as **the** product of exposure duration (years) x 365 days/year.

e = Calculated as the product of 70 years (assumed lifetime) x 365 days per year.

f = Assuming one day per **week** exposure.

g = Assuming trespassing occurs during the 10-year adolescent/teenage period.

NA = Not applicable.

L/day = liters per day

cm^2 = square centimeter

mg/cm^2 = milligrams per square centimeter

mgiday = milligrams per day

kg/mg = kilograms per milligram

Table 6-4
Central Tendency Parameters Used to Estimate CDI

Pathway Parameters	Resident Adult	Resident Child	Adult Worker	Units
Ingestion Rate (soil)	50[a]	100[a]	50[a]	mg/day
Ingestion Rate (water)	1.4 x 0.75	1 x 0.75	1 x 0.75	L/day
Exposure Frequency	234[b]	234[b]	219[b]	days/year
Exposure Duration	7[c]	2[c]	5[c]	years
Dermal Contact Area	4,100[a]	2,900[a]	4,100[a]	cm^2
Skin Adherence Factor	1	1	1	mg/cm^2
Absorption Factor	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	unitless
Oral Absorption Efficiency	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	unitless
Conversion Factor	1E-6	1E-6	1E-6	kg/mg
Body Weight	70[a]	15[a]	70[a]	kg
Averaging Time, Noncancer	2,555[d]	703[d]	1,825[d]	days
Averaging Time, Cancer	25,550[e]	25,550[e]	25,550[e]	days

Notes:

a = USEPA (1989a) *Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual (Part A)*.
b = USEPA (1991b) *Risk Assessment Guidance for Superfund Vol. I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, Interim Final*, OSWER Directive: 9285.6-03.EPA/600/8-89/043.
c = USEPA (1991a), *Risk Assessment Guidance for Superfund: Vol. I — Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)*, OSWER Directive 9285.7-01B.
d = Calculated as the product of ED (years) x 365 days/year.
e = Calculated as the product of 70 years (assumed lifetime) x 365 days per year.
f = Assuming one day per week exposure.
NA = Not applicable.

In accordance with RAGS, the adult and child intake variables will be combined to estimate exposure to carcinogens. This factor, referred to as the lifetime weighted average (LWA), considers the difference in daily ingestion rates for soil and drinking water, body weights, and exposure durations for children (ages 1 to 6) and adults (ages 7 to 31). The exposure frequency is assumed to be identical for the adult and child exposure groups; an example is shown after the equations presented below.

Before quantifying soil exposure, it is first necessary to derive the appropriate fraction ingested or contacted (FI/FC) from contaminated area factors for each applicable COPC. These factors are derived by evaluating the spatial distribution of COPCs. The FI/FC was not computed because upper confidence limits (UCLs) were used to provide upper-bound EPCs.

A CPSS not eliminated from the HHRAs based on the screening comparisons still could be eliminated as a COPC if the UCL concentration does not exceed the corresponding background concentration or RBC. In addition, groundwater COPCs were eliminated if they were detected in Phase I samples but not in subsequent sampling rounds.

HHRAs are composed of many tables, which serve only as an intermediate check when reviewing the document. The CDI equations, which can be solved assuming a concentration of 1, result in a universal multiplier. Multipliers developed for each land-use scenario are shown in Table 6-5.

Table 6-5
Multipliers' Used to Estimate Chronic Daily Intake

		Soil		Groundwater
		Ingestion	*Dermal* Contact	Ingestion
Exposure Scenario	Exposure Type	All Chemicals	Organics[b]	All Chemicals'
Resident	Noncarcinogens (adult)	1.37E-6	5.62E-7	2.74E-2
	Noncarcinogens (child)	1.28E-5	1.85E-6	6.39E-2
	Carcinogens (LWA)	1.57E-6	3.51E-7	1.49E-2

Table 6-5
Multipliers[a] Used to Estimate Chronic Daily Intake

		Soil		Groundwater
		Ingestion	*Dermal* Contact	Ingestion
Exposure Scenario	**Exposure Type**	**All Chemicals**	**Organics[b]**	**All Chemicals[c]**
Site Worker	Noncarcinogens	4.89E-7	4.01E-7	9.78E-3
	Carcinogens	1.75E-7	1.43E-7	3.49E-3

Notes:
NA = Not applicable
a = The product of the multiplier and the EPC equals the CDI fur a given chemical assuming an RME scenario.
b = The multiplier for inorganics is multiplied by a factor of 0.1 to account for the dermal absorption factor of 0.001 for inorganics; the multiplier for organic chemicals includes the 0.01 factor.
c = The ingestion intake is also used to address inhalation risk in accordance with USEPA's Supplemental Guidance to RAGS Bulletin 3, *Exposure Assessment*; ingestion risk is approximately equal to risk posed by dermal and inhalation exposure while showering. This is applied to VOCs only.

6.1.4 Toxicity Assessment

The toxicity assessment presents assumptions used to evaluate risk posed by individual compounds found in site soil and groundwater. Toxicological profiles for each COPC are included in the BRA. However for the ROD, information from the toxicological profiles f r the COPCs has been summarized in Table 6-6.

Carcinogenicity and *Noncancer* Effects

USEPA has established a classification system for rating the potential carcinogenicity of environmental contaminants based on the weight of scientific evidence· Cancer weight-of-evidence class "A" (human carcinogens) means that human toxicological data have shown a proven correlation between exposure and the onset of cancer (in varying forms). The "Bl" classification indicates some human exposure studies have implicated the chemical as a probable carcinogen. Weight-of-evidence class "B2" indicates a possible human carcinogen, a description

Table 6-6
Toxicological Reference Information
for Chemicals of Potential Concern
Site 15, NAS Pensacola

	Noncarcinogenic Toxicity Data										Carcinogenic Toxicity Data					
Chemical	Oral Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Oral	Inhalation Reference Dose (mg/kg-day)		Confidence Level	Critical Effect	Uncertainty Factor Inhalation	Oral Slope Faction (kg-day/mg)		Inhalation Slope Factor (kg-day/mg)		Weight of Evidence	Tumor Type
Aldrin	3E-05	a	M	Liver toxicity	1,000	NA		NA	NA	NA	17	a	17.1	a	B2	Liver carcinoma
Aluminum	1	b	NA	NA	NA	NA		NA	NA	NA	NA		NA		NA	NA
Arsenic	0.0003	a	M	hyperpigmentation	3	NA		NA	NA	NA	1.5	a	15.1	a	A	various
BEQ	NA		NA	NA	NA	NA		NA	NA	NA	7.3	a	6.1	c	B2	mutagen
Chlordane	6E-05	a	L	liver hypertrophy	NA	NA		NA	NA	NA	1.3	a	NA		B2	liver carcinoma
Chromium III	1	a	L	NA	100/10	NA		NA	NA	NA	NA		42	a	D	NA
Dieldrin	5E-05	a	M	liver lesions	100	NA		NA	NA	NA	16	a	NA		B2	hepatocarcinoma
Heptachlor epoxide	0.000013	a	L	liver weight increase	1000	NA		NA	NA	NA	9.1	a	NA		B2	liver carcinoma
Manganese (food)	0.047	a	NA	neurological effects	1	NA		NA	NA	NA	NA		NA		D	NA
Manganese (water)	0.023	a	NA	neurological effects	1	1.43E-05	a	M	neurological effects	1000	NA		NA		D	NA

Notes:

a = Integrated Risk Information System (IRIS)
b = EPA NCEA - Cincinnati (provisional)
c = Withdrawn from IRIS/HEAST
NA = Not Applicable or not available
L = Low confidence
M = Medium confidence
mg/kg-day = milligrams per kilogram per day
kg-day/mg = kilograms per day per milligram

A = Human Carcinogen
B1 = Probable Human Carcinongen
B2 = Possible Human Carcinogen
D = Not Classifiable for its carcinogenic potential

based on carcinogenicity in laboratory animals but lacking confirmatory human data. Weight-of-evidence class "C" identifies possible human carcinogens, and class "D" indicates a chemical not classifiable for its carcinogenic potential. The USEPA has established slope factors (SFs) for carcinogenic chemicals. The SF is defined as a "plausible upper-bound estimate of the probability of a response (cancer) per unit intake of a chemical over a lifetime" (USEPA, 1989a).

In addition to potential carcinogenic effects, most chemicals can also produce other toxic responses at doses greater than experimentally derived threshold concentrations. The USEPA has derived reference dose (RfD) values for these chemicals. A chronic RfD is defined as, "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure concentration for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime" These toxicological values are used when estimating risk to assess the upper-bound level of cancer risk and noncancer hazard associated with exposure to a given contaminant concentration.

For carcinogens, the potential excess risk posed by a chemical is computed by multiplying the CDI (mglkg-day) by the SF (kg-day/mg). The HQ (for noncarcinogens) is computed by dividing the CDI by the RfD (mg/kg-day). The USEPA has set standard limits (or points of departure) for carcinogens and noncarcinogens to evaluate whether significant risk is posed by a chemical (or combination of chemicals). For carcinogens, the point of departure is 1E-06, with a generally accepted range of 1E-06 to 1E-04. These risk values correlate with a one-in-10,000 and a one-in-1 million excess cancer incidence resulting from exposure to xenobiotics.

For noncarcinogens, other toxic effects are generally considered possible if the HQ (or sum of HQs for a pathway, HI) exceeds 1.0. Although both cancer risk and noncancer hazard are generally additive (within each group) only if the target organ is common to multiple chemicals, a most conservative estimate of each may be obtained by summing the individual risks or hazards, regardless of target organ. The following HHRAs have taken the universal summation approach for each class of toxicant. Risk formulae applied to site data are detailed in the Risk Characterization section of this document.

Critical studies used in establishing SFs and RfDs by USEPA are shown in the Integrated Risk Information System (IRIS) database (primary source) and/or Health Effects Assessment Summary Tables (HEAST), Fiscal Year 1995 (secondary source). If toxicological information is unavailable in IRIS or HEAST, values were obtained from reports issued by the Environmental Criteria and Assessment Office (ECAO)/National Center for Environmental Assessment (NCEA). Where applicable, these values were also included in the database for this HHRA.

6.1.5 Risk Characterization

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

RISK = CDI x CSF

where:

RISK = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
CSF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are generally expressed in scientific notation (e.g., $1\text{X}10^{-6}$ or 1E-6). **An excess** lifetime cancer risk of $1\text{x}10^{-6}$ indicates that, as a reasonable maximum estimate, an individual has a one in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under specific exposure conditions at OU 4. The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time (e.g., lifetime) with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called an HQ. The HI can be generated by adding the HQs for all COCs that affect the same target organ within a medium or across all media to which a given population may reasonably be exposed.

The HQ is calculated as follows:

Noncancer HQ = CDI/RfD

where:

CDI = Chronic Daily Intake
RfD = Reference Dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

To evaluate estimated cancer risks, a risk level lower than $1x10^{-6}$ is considered a minimal or de minimis risk. The risk range of $1x10^{-6}$ to $1x10^{-4}$ is an acceptable risk range for USEPA and would not be expected to require a response action. A risk level greater than $1x10^{-4}$ would be evaluated further, and a remedial action to decrease the estimated risk considered. The State of Florida considers risk of $1x10^{-6}$ and an HI of 1 acceptable.

An HI of less than unity (1.0) indicates that the exposures are not expected to cause adverse health effects. An HI greater than one (1.0) requires further evaluation. For example, although HQs of several chemicals present are added and exceed 1.0, further evaluation may show that their toxicities are not additive because each chemical affects different target organs. When total effects are evaluated on an effect and target organ basis, the HI of the separate chemicals may be at acceptable levels.

Carcinogenic **risks** and noncarcinogenic hazards were evaluated for potential exposures to media-specific COCs in surface soil, surface water, surface sediment, and groundwater. Receptor populations were potentially exposed workers, trespassers, and future residents that could, theoretically, use groundwater for a household water source. Risks and hazards for the identified COCs are summarized in Table 6-7.

Estimated potential exposure to COCs in surface water or sediment did not result in unacceptable carcinogenic risk or noncarcinogenic hazard. Current site workers and potential child trespassers did not have an individual pathway or combined single medium pathway with an HI in excess of 0.6 or an ILCR greater than 2E-6. The cross-pathway HI and cancer **risk** for these two receptor types were also within the acceptable carcinogenic risk range. These projections indicate that neither group is **at** significant risk of deleterious health effects resulting from RME to all media. These receptor groups do not warrant further consideration.

6.1.6 Site Risk Summary

6.1.6.1 Summary of Surface Soil Risk

The Site 15 COCs identified for surface soil in the HHRA are alpha-chlordane, arsenic, benzo(a) pyrene equivalents (BEQs), dieldrin, and gamma-chlordane. Remedial goals for site resident are presented in Table 6-8. For more information regarding residential risk, reference the RI.

Table 6-7
Risk and Hazard for Identified COCs and Pathways of Concern

	Site Resident			Site Worker	
Chemical	**Adult HQ**	**Child HQ**	**ILCR**	**Adult HQ**	**Adult ILCR**
Incidental Ingestion of Surface Soil					
Aldrin	0.000091	0.0009	5.3E-08	0.000033	6.0E-09
Alpha-Chlordane	0.011	0.099	9.5E-07	0.0038	1.1E-07
Arsenic	0.082	0.77	4.2E-05	0.029	4.7E-06
BEQ	NA	NA	1.2E-06	NA	1.3E-07
Dieldrin	0.025	0.23	2.3E-05	0.0089	2.5E-06
gamma-Chlordane	0.021	0.20	1.9E-06	0.0075	2.1E-07
Heptachlor epoxide	0.00063231	0.0059	8.6E-08	0.00022569	9.6E-09
Manganese	0.0057	0.053	NA	0.0020	NA
Cumulative HI or ILCR	0.1	1.4	7E-05	0.05	8E-06
Dermal Contact with Surface Soil					
Aldrin	0.000075	0.00024667	2.4E-08	0.000053	9.7E-8
Alpha-Chlordane	0.009	0.029	4.3E-07	0.0062	1.7E-07
Arsenic	0.017	0.056	4.7E-06	0.012	1.9E-06
BEQ	NA	NA	5.3E-07	NA	2.2E-07
Dieldrin	0.020	0.067	1.0E-05	0.015	4.2E-06
gamma-Chlordane	0.017	0.057	8.4E-07	0.012	3.4E-07
Heptachlor epoxide	0.00051877	0.0017	3.8E-08	0.00037015	1.6E-08
Manganese	0.0012	0.0038	NA	0.00083251	NA
Cumulative HI or ILCR	0.06	0.2	2E-05	0.05	7E-06

Table 6-7
Risk and Hazard for Identified COCs and Pathways of Concern

	Site Resident			Site Worker	
Chemical	**Adult HQ**	**Child HQ**	**ILCR**	**Adult HQ**	**Adult ILCR**
Incidental Ingestion of Groundwater (Area 1)					
Arsenic	20	47	4.9E-03	7.1	1.1E-03
Dieldrin	0.0071	0.016	3.1E-06	0.0025	7.2E-07
Cumulative HI or ILCR	20	47	5E-03	7	1E-03
Incidental Ingestion of Groundwater (Area 2)					
Arsenic	8.0	19	2.0E-03	3	5.0E-04
Dieldrin	0.021	0.050	9.3E-06	0.0076	2.2E-06
Cumulative HI or ILCR	8	19	2E-03	3	5E-04

Notes:
NA = not applicable
HQ = hazard quotient
ILCR = incremental lifetime excess cancer risk

Table 6-8
Surface Soil Remedial Goal Options for Site Resident
Site 15 — NAS Pensacola

			Site Resident						
Chemical	**EPC (mg/kg)**	**HI**	**HI = 0.1**	**HI = 0.1**	**HI = 3.0**	**ILCR**	**ILCR = 1E-6**	**ILCR = 1E-5**	**ILCR = 1E-4**
Arsenic	18.03	0.78	2.31	23.1	69.4	4.3E-05	0.416	4.16	41.6
alpha-Chlordane	0.466	0.11	0.41	4.1	12.3	1.2E-06	0.401	4.01	40.1
BEQ	0.104	NA	NA	NA	NA	1.5E-06	0.071	0.71	7.1
Dieldrin	0.907	0.27	0.34	3.4	10.2	2.8E-05	0.033	0.33	3.3
gamma-Chlordane	0.918	0.22	0.41	4.1	12.3	2.3E-06	0.401	4.01	40.1

Notes:
RGO = Remedial Goal Option, calculated in accordance with RAGS, based on the child receptor for site residents
EPC = Exposure Point Concentration
HI = Hazard Index
ILCR = Incremental Lifetime Excess Cancer Risk
mg/kg = milligrams per kilogram
Calculated in accordance with RAGS including the Site Resident Incidental Ingestion and Dermal Contact Exposure Pathways.

Hazard Index (HI) Summary

All 15 soil sample locations had a cumulative HI of less than 1 under the industrial scenario.

Incremental Lifetime Cancer Risk (ILCR) Summary

Twenty-four sample locations had reported concentrations resulting in an industrial cumulative risk greater than 1E-6. Arsenic was the primary risk driver at the 24 locations with contributions from dieldrin at two locations and alpha-chlordane and BEQs at one location each. Figure 6-1, Cumulative Risk in Site 15 Surface Soil Industrial Scenario, presents the cumulative point risk calculated for the site worker at Site 15 soil sampling locations.

6.1.6.2 Summary of Groundwater Risk

The Site 15 groundwater COCs are arsenic and dieldrin.

HI Summary

Six of the 28 well locations had reported concentrations resulting in an industrial cumulative HI greater than 1, with arsenic as the primary hazard driver.

ILCR Summary

The 28 wells sampled had reported concentrations resulting in both residential and industrial cumulative risk greater than 1E-6 (See Figure 6-2). However, only seven locations had arsenic concentrations exceeding the FPDWS (50 μg/L). Arsenic was the primary risk driver in groundwater. Dieldrin contributed to the risk estimates at 19 well locations. However, the FGGC for dieldrin is 0.1 μg/L. Analytical results indicated the FGGC was exceeded at one well, 15GS68 (0.11 μg/L). This value is considered essentially equivalent to the FGGC; subsequent sampling did not confirm the presence of dieldrin. Therefore, dieldrin concentrations in groundwater do not warrant further attention during the FS.

SCALE

0 feet 200

LEGEND - RISK VALUES

- NOT SAMPLED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

RECORD OF DECISION
NAS PENSACOLA
PENSACOLA, FLORIDA

FIGURE 6-1
CUMULATIVE RISK
IN SITE 15 SURFACE SOIL
INDUSTRIAL SCENARIO

/home4/pensacola-dir/risk-assess/site-15-dir/soil-dir/cumu.aml

FIGURE 6-2
ARSENIC R SK
IN S TE 15 SHALLOW GROUNDWAT
INDUSTRIAL SCENARIO

Remedial Goal Options

RGOs are chemical concentrations computed to equate with specific risk and/or hazard goals that may be established for a particular site. As previously discussed, a COC is any COPC that significantly contributes to a pathway of concern. A pathway having an ILCR greater than 1E-06 or an HI greater than 1 is defined as a pathway of concern, and an individual chemical which contributes 0.1 HQ to a cumulative HI exceeding 1.0 is considered to significantly contribute to the pathway ILCR or HI. Based on this method, COCs were identified which required calculating RGOs. These are listed in the risk characterization section of the HHRA. Inclusion in the RGO table does not necessarily indicate that remedial action will be required to address a specific chemical. Instead, RGOs are provided to facilitate risk management decisions.

In accordance with USEPA Region IV Supplemental Guidance to RAGS, Development of Risk-Based *Remedial* Options (USEPA, 1995a), RGOs were calculated at 1E-04, 1E-05, and 1E-06 risk levels for carcinogenic COCs and HQ goals of 3, 1, and 0.1 for noncarcinogenic COCs. RGOs for carcinogens were based on the LWA and the adult site worker. Groundwater RGOs for the site resident and site worker are presented in separate tables (where applicable) in each site-specific HHRA. Hazard-based RGOs were calculated based on either the hypothetical site resident or the adult site worker, as noted in the each corresponding table. Tables 6-8 and 6-9 present RGOs for COCs identified in soil and Tables 6-10 through 6-13 present RGOs for COCs identified in groundwater.

Table 6-9
Surface Soil Remedial Goal Options for Site Worker
Site 15 – NAS Pensacola

			Site Worker						
Chemical	**EPC (mg/kg)**	**HI**	**HI = 0.1**	**HI = 1.0**	**HI = 340**	**ILCR**	**ILCR = 1E-6**	**ILCR = 1E-5**	**ILCR = 1E-4**
Arsenic	18.03	0.032	56.7	567	1700	5E-06	3.53	35.3	353
alpha-Chlordane	0.466	0.0069	6.7	67	202	2E-07	2.42	24.2	242

Table 6-9
Surface Soil Remedial Goal Options for Site Worker
Site 15 — NAS Pensacola

Chemical	EPC (mg/kg)	HI	HI = 0.1	HI = 1.0	HI = 3.0	ILCR	ILCR = 1E-6	ILCR = 1E-5	ILCR = 1E-4
			Site Worker						
BEQ	0.104	NA	NA	NA	NA	2E-07	0.43	4.3	43
Dieldrin	0.907	0.016	5.6	56	168	5E-06	0.20	2.0	20
Chlordane	0.918	0.014	6.7	67	202	4	2.42	24.2	242

Notes:
RGO = Remedial Goal Option, calculated in accordance with RAGS, based on the child receptor for site residents
EPC = Exposure Point Concentration
HI = Hazard Index
ILCR = Incremental Lifetime Excess Cancer Risk
mg/kg = milligrams per kilogram
Calculated in accordance with RAGS including the Site Worker Incidental Ingestion and Dermal Contact Exposure Pathways.

Table 6-10
Groundwater Remedial Goal Options for Site Resident
Site 15 — Exposure Area 1
NAS Pensacola

Chemical	EPC (mg/L)	HI	HI = 0.1	HI = 1.0	HI = 3.0	ILCR	ILCR = 1E-6	ILCR = 1E-5	ILCR = 1E-4
			Site Resident						
Arsenic	0.219	47	0.00047	0.0047	0.014	4.9E-03	0.000045	0.00045	0.0045
Dieldrin	0.0000129	0.0165	0.00008	0.0008	0.002	3.1E-06	0.0000042	0.000042	0.00042

Notes:
RGQ = Remedial Goal Option, calculated in accordance with RAGS, based on the child receptor for site residents
EPC = Exposure Point Concentration
HI = Hazard Index
ILCR = Incremental Lifetime Excess Cancer Risk
mg/L = milligrams per liter
Calculated in accordance with RAGS including the Site Resident Incidental Ingestion Exposure Pathway.

Table 6-11
Groundwater Remedial Goal Options for Site Worker
Site 15 – Exposure Area 1
NAS Pensacola

			Site Worker						
Chemical	**EPC (mg/L)**	**HI**	**HI = 0.1**	**HI = 1.0**	**HI = 3.0**	**ILCR**	**ILCR = 1E-6**	**ILCR = 1E-5**	**ILCR = 1E-4**
[illegible]	0.219	7.1	0.0031	0.031	0.092	1.1E-03	0.00019	0.0019	0.019
Dieldrin	0.0000129	0.0025	0.00051	0.0051	0.015	7.2E-07	0.000018	0.00018	0.0018

Notes:
RGO = **Remedial** Goal Option, calculated in accordance with RAGS, based on the child receptor for site residents
EPC = **Exposure** Point Concentration
HI = Hazard **Index**
ILCR = Incremental Lifetime Excess Cancer **Risk**
mg/L = **milligrams** per liter
Calculated in accordance with RAGS **including** the Site **Worker** Incidental Ingestion **Exposure Pathway**

Table 6-12
Groundwater Remedial Goal Options for Site Resident
Site 15 – Exposure Area 2
NAS Pensacola

			***Site* Residant**						
Chemical	**EPC (mg/L)**	**HI**	**HI = 0.1**	**HI = 1.0**	**HI = 3.0**	**ILCR**	**ILCR = 1E-6**	**ILCR = 1E-5**	**ILCR 1E-4**
Arsenic	0.091	47	0.00020	0.0020	0.0059	4.9E-03	0.000019	0.00019	0.0019
Dieldrin	0.000039	0.0165	0.00024	0.0024	0.0071	3.1E-06	0.000013	0.00013	0.0013

Notes:
RGO = Remedial **Goal Option,** calculated in accordance with RAGS, based on the child receptor for site residents
EPC = **Exposure** Point Concentration
HI = Hazard **Index**
ILCR = Incremental Lifetime **Excess Cancer Risk**
mg/L = **milligrams per liter**
Calculated in **accordance** with **RAGs including the Site** Resident Ingestion **Exposure** Pathway.

Table 6-13
Groundwater Remedial Goal Options for Site Worker
Site 15 – Exposure Area 2
NAS Pensacola -

			Site Worker						
Chemical	**EPC (mg/L)**	**HI**	**HI = 0.1**	**HI = 1.0**	**HI = 3.0**	**ILCR**	**ILCR = 1E-6**	**ILCR = 1E-5**	**ILCR = 1E-4**
Arsenic	0.091	7.1	0.0013	0.013	0.038	1.1E-03	0.00008	0.0008	0.008
Dieldrin	0.000039	0.0025	0.00155	0.0155	0.046	7.2E-07	0.000054	0.00054	0.0054

Notes:
RGU = Remedial **Goal** Option, calculated in accordance with **RAGS.** based on the child receptor for site residents
EPC = Exposure Point Concentration
HI = Hazard **Index**
ILCR = Incremental Lifetime Excess Cancer Risk
mg/L = milligrams **per** liter
Calculated in accordance with RAGs including **the** Site Resident Ingestion Exposure Pathway.

6.1.7 Risk Uncertainty

Uncertainty associated with estimating chemical uptake from exposure to groundwater is summarized here. For a complete description of the uncertainties associated with the HHRA see the RI (EnSafe, 1997).

The primary source of uncertainty in the groundwater exposure pathway is the potable use assumption, which represents a highly conservative approach to assessing the significance of groundwater impacts. Site 15 continues to be used to store and mix fertilizer, pesticides, and herbicides associated with golf course maintenance activities. Municipal water lines service the site and industrial activities; therefore, groundwater below Site 15 is not currently used as a potable or industrial source. It is not anticipated that groundwater below Site 15 would be used as a potable supply in the future; therefore, no exposure to contaminated groundwater is expected.

Supplemental guidance was presented in draft form in June 1994 by USEPA Region IV to streamline the approach used to address contaminant inhalation via the groundwater exposure pathway. According to the draft supplemental guidance? the CDI for the inhalation pathway is equivalent to that of the ingestion pathway, where 2 liters of groundwater are ingested daily.

According to the draft guidance, the risk/hazard posed by the pathways is cumulative; two times the oral ingestion pathway CDI has been proposed as an equivalent calculation for the cumulative ingestion and inhalation exposure pathways. Previously, these pathways were calculated separately using chemical-specific factors and pathway-specific exposure assumptions. In addition to these factors, this draft method does not consider fugacity (i.e., the propensity for a substance to "break free" from the containing medium) as part of the suggested calculation. This proposed method includes the inhalation reference dose or slope factor, but it is applied to the ingestion formula.

A similar approach for limiting RME uncertainties was taken for groundwater. It would be implausible to expect an individual to be chronically exposed tu the maximum concentration of each groundwater chemical. Substitution of the 95% UCL mean concentration for each chemical provides a reasonably conservative estimate of the chronic concentrations to which an individual may be exposed via the groundwater pathway. Spatial analysis shows that inorganic and organic COPCs did not consistently coexist, and detections appeared to be random rather than suggestive of a defined plume.

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (e.g., future residential use) recommended by USEPA Region IV when assessing potential and current exposure. The exposure assumptions made in the site worker scenario are also very conservative and would tend to overestimate exposure. Current site workers are not exposed to site groundwater and contact with soil is expected to be minimal due to coverage by existing features.

Future residential use of Site 15 resulting in exposure to current soil conditions is unlikely. If this area were developed as residential sites, most of the present buildings would be razed and the surface soil conditions would likely change — the existing soil could be covered with roads, driveways, landscaping soils, or structures — or parts of the property could be made into playgrounds. These factors indicate that exposure pathways assessed in the HHRA would generally overestimate the risk and hazard posed tu current site workers and future residents.

The following uncertainties are associated with estimation of risks:

In hazard and risk evaluations, risks or hazards presented by several chemicals reported for the same exposure have been added to provide a sum of estimated total risk or hazard for that particular exposure. This conservative assumption is scientifically accurate only where individual chemical health effects are directed at the same effect and same target organ. Effects may be additive, synergistic, or antagonistic. Since many chemicals have different noncarcinogenic actions or targets, this approach may overestimate risk.

Risks calculated from slope factors are derived using a linearized multistage procedure; therefore, they are likely to be conservative upper-bound estimates. Actual risks may be much lower.

6.2 Ecological Risk Assessment

The eastern cottontail rabbit and the American robin were selected as assessment endpoint wildlife species for the BRA's ecological component. as no endangered species were identified at the site. This risk evaluation indicates potential sub-lethal effects to these species from maximum detected arsenic, mercury, and possibly surfaces soil pesticide concentrations. However, associated calculations are based on conservative assumptions (i.e., the rabbit or robin receives 100% of its diet from areas of maximum contaminant concentrations), which in reality, do not occur, Downgradient surface water, sediment, and biota (within Bayou Grande and Wetland 65) were not at risk from the site, given their distance, the shallow groundwater quality adjacent to the water bodies, and the nature and limited extent of site-impacted groundwater. The bayou and wetland will be further evaluated during the RIs for Sites 40 and 41.

7.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

The Site 15 FS report presented the remedial volumes to be addressed and detailed analysis of five potential groundwater remedial options and four soil remedial options. These alternatives were developed to provide a range of site remedial actions. This ROD section summarizes the alternatives described in the FS report.

The groundwater alternatives presented in the FS were:

- Alternative 1 — No action
- Alternative 2 — Monitored natural attenuation
- Alternative 3 — Groundwater recovery and discharge to federally-owned treatment works (FOTW)
- Alternative 4a — Groundwater recovery and ex-situ coagulation/precipitation
- Alternative 4b — Groundwater recovery and ex-situ ionic exchange

The soil alternatives presented were:

- Alternative 1 — No action
- Alternative 2 — Institutional controls
- Alternative 3 — Limited excavation to industrial scenario and offsite disposal
- Alternative 4 — Asphalt cover with institutional controls and limited excavation

The goal of the FS is to select remedies based on the fundamental criteria including: (1) protecting human health and the environment, (2) complying with ARARs, and (3) reducing untreated hazardous waste.

7.1 Remedial Volumes

Remedial volumes were developed based on remedial goals presented in the HHRA and governing ARARs. Remedial Goals for surface soil and groundwater are presented in Section 7.1.1 and remedial volumes are in Section 7.1.2.

7.1.1 Remedial Goals

Site 15 Remedial Goals, which have been proposed to protect human health and the environment, given current and future land use, are set at an industrial point risk of 1E-06. That is to say, the risk pathways from exposure to contaminated groundwater and soil will be eliminated to a level protective of site workers. Based on industrial use, institutional controls will be implemented in accordance with the LUCAP between Florida, USEPA, and the U.S. Navy. This industrial RE is in lieu of the 1E-06 residential risk threshold as outlined by FDEP. With the use of the LUCAP, FDEP would not require remediation of surface soil to levels lower the Soil Cleanup Target Levels (SCTLs) for industrial use. These concentrations, presented in Table 7-1, were used to calculate remedial volumes.

Table 7-1
Soil Threshold Concentrations

Parameter	Concentration (mg/kg)
Arsenic	3.7
BEQs	0.5
Dieldrin	0.3
chlordane	11.0

Site 15 contaminant concentrations exceed the FDEP SCTLs in surface soil at 23 sample locations. The primary contaminant at these locations is arsenic, with dieldrin contamination at sample locations 15S04, 15S14, and 15S15 and BEQ contamination at sample location 15S21. Sample location 15S16, one of the 23 locations, is beneath Building 2640, where the exposure pathway is incomplete. The remaining sample locations exceeding the threshold are not covered.

Groundwater RGs are FPDWS, FSDWS, FSWQS, or MCLs, whichever is more stringent. Guidance concentrations (i.e., FGGCs) are to-be-considered (TBCs). Samples from ten monitoring well locations exceeded arsenic's RGs, although samples from only seven locations exceeded the FPDWS of 50 μg/L. The other three locations exceeded the arsenic RG, but were less than the FPDWS.

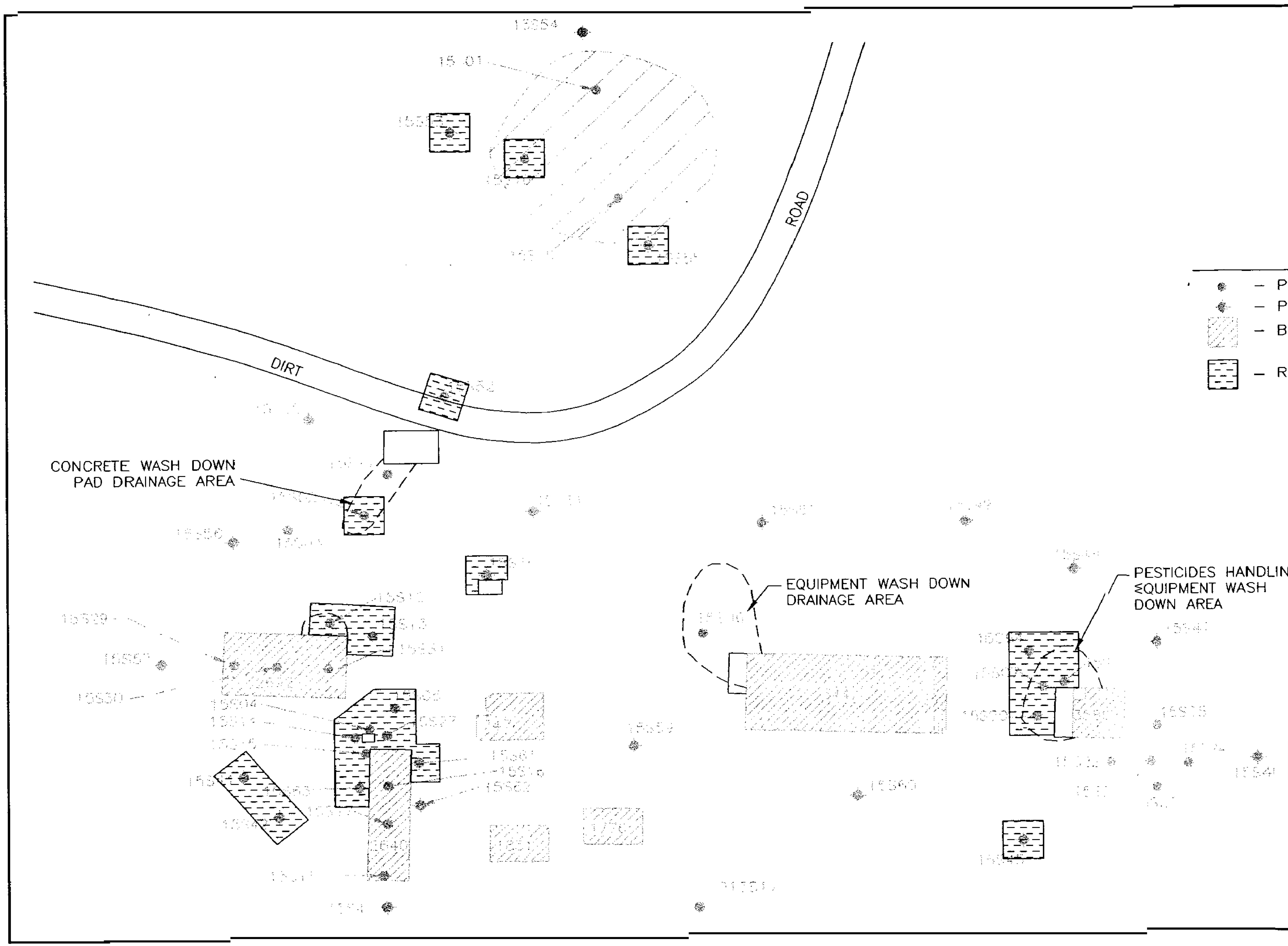
Using these remedial goals, the remedial action alternatives were developed. The contaminated areas requiring remediation are shown on Figure 7-1 for soil and Figure 7-2 for groundwater. How each alternative will address contamination at Site 15 and an estimated cost are described below.

7.1.2 Remedial Volumes

Remedial volumes for soil and groundwater cleanup were based on the contaminants exceeding Site 15 RGs.

7.1.2.1 Remedial Soil Volumes

During the FS, site soil was screened using residential hazard and risk. RGs based on land use remaining industrial, which were presented in the HHRA for a future site worker, are FDEP's SCTLs. Where contamination was not completely delineated, remedial soil volumes were calculated on a sample-point basis to a depth of 2 feet bgs and a 10-foot radius to estimate cost and soil volumes. The criteria to develop remedial volumes are presented below.



RECORD OF DECISION
SITE 15
NAS PENSACOLA

FIGURE 7–1
SOIL REMEDIATION AREAS

DWG DATE: 11/18/98 | DWG NAME: 0083B007

FIGURE 7–2
GROUNDWATER REMEDIATION AREAS

- Sample locations with cumulative risk less than the industrial-based goal of 1E-06 were eliminated from further evaluation under the FS.

- Sample locations with contaminant concentrations greater than FDEP SCTLs were used to delineate the area and volume of surface soil to be evaluated for remedial alternatives in the FS.

- Sample location 15S16 was excluded from proposed remediation since it is beneath Building **2640** and protected from receptors.

Contaminant-specific screening of point risk data indicates that **23** Site 15 sample locations exceed the risk threshold levels for future site workers. These areas are presented in Table *7-2,* Site 15 Surface Soil Volume Estimates. Figure 7-1, Soil Exceeding Remedial Goals, shows the areas listed in Table 7-2. The total estimated volume of soil requiring further evaluation at Site 15 is 580 yd^3.

Table 7-2
Site 15 Surface Soil Volume Estimates

Affected Area Designation	Contaminants Exceeding RG	Soil Volume Affected (yd^3)	Basis
15S04, S05, S14, S15, S27, S61, S63	Arsenic, Dieldrin	140	Exceeds FDEP SCTLs
15S12, S13	Arsenic	80	Exceeds FDEP SCTL
15S41, S42	Arsenic	80	Exceeds FDEP SCTL
15S07, S20, S21, S64	Arsenic, BEQ	80	Exceeds FDEP SCTLs
15S02	Arsenic	30	Exceeds FDEP SCTL
15S10	Arsenic	30	Exceeds FDEP SCTL

Table 7-2
Site 15 Surface Soil Volume Estimates

Affected Area Designation	Contaminants Exceeding RG	Soil Volume Affected (yd^3)	Basis
15S45	Arsenic	30	Exceeds FDEP SCTL
15S52	Arsenic	30	Exceeds FDEP SCTL
15S53	Arsenic	30	Exceeds FDEP SCTL
15S55	Arsenic	30	Exceeds FDEP SCTL
15S58	Arsenic	20	Exceeds FDEP SCTL
Total Soil Volume		**580**	

7.1.2.2 Remedial Groundwater Volumes

Shallow groundwater under approximately 40,000 square feet (sf) of Site 15 is contaminated by arsenic. Figure 7-2, Site 15 Groundwater Remediation Areas, shows the area of shallow groundwater contamination, which was determined by the data review presented in the FS. To determine the total volume of groundwater requiring remedial action, an effective water-bearing porosity of *35%* was assumed for the shallow groundwater zone. The total surface area of groundwater contamination was multiplied by the aquifer thickness (20 feet) and porosity, then converted to gallons, resulting in an estimated contaminated water volume of 2.1 million gallons.

7.2 Groundwater Alternatives

7.2.1 Alternative 1: No Action

The cost for Alternative 1, presented below, is considered the maximum case scenario.

Capital Cost:	$0.00
Operation & Maintenance (O&M) Present Worth:	$0.00
Five year annual review:	$10,000 per review
Net Present Worth:	$24,400

The NCP requires consideration of a no-action alternative as a baseline against which other alternatives are compared. In the no-action alternative, no further action will be taken to contain, remove, or treat groundwater in which contamination exceeds performance standards.

Health risks for potential future residents will remain and no chemical-specific ARARS will be met. This alternative does not meet the effectiveness criterion because it does not reduce future exposures fur the unlikely future child resident through exposure to groundwater. Contaminated waste/soil may threaten site groundwater.

7.2.2 Alternative 2: Monitored Natural Processes/Institutional Controls

The cost for Alternative 2, presented below, is considered the maximum case scenario.

Capital Cost:	$103,150
O&M Present Worth:	$537,000
Remedial Action Contractor:	$100,000
Total Cost:	$740,000

This alternative would include:

- Institutional controls imposed in accordance with the LUCAP to restrict groundwater use of the surficial zone of the Sand-and-Gravel **Aquifer** within 300 feet of the site.

- Annual review of the institutional controls and certification that the controls should remain in place or he modified to reflect changing site conditions.

- Installation of at least two additional monitoring wells; one north of 15GS70 and one east of 15GR66 and south of 15GS71.

- Groundwater monitoring to ensure that natural attenuation processes would be effective and that contaminants exceeding performance standards did not migrate.

- A review during which the Navy would determine whether groundwater performance standards continue to be appropriate and if natural attenuation processes are effective.

- Continued groundwater monitoring at sampling intervals to be established by the Navy, with FDEP and USEPA concurrence. The groundwater monitoring program would continue until the alternative has achieved continued attainment of the performance standards and remains protective of human health and the environment.

Groundwater samples would be collected in accordance with the monitoring plan to be completed during remedial design. Proper well construction and development techniques, along with a low-flow sampling method, would be used during the monitoring. The Navy may revise the groundwater monitoring program sampling intervals with USEPA and FDEP concurrence.

7.2.3 Alternative 3: Groundwater Recovery and Discharge to FOTW

The cost for Alternative 3, presented below, is considered the maximum case scenario.

Capital Cost:	$248,000
O&M Present Worth:	$253,000
Monitoring (Present Worth):	$102,300
Total Cost	$603,300

This alternative includes:

- Construction of two groundwater extraction wells with associated pumps and wiring.
- Construction of piping and connection into the FOTW's sanitary sewer line.
- Groundwater monitoring of the site for arsenic to evaluate the system's effectiveness.
- Institutional controls imposed in accordance with the LUCAP to restrict groundwater use of the surficial zone of the Sand-and-Gravel **Aquifer** within 300 feet of the site until performance goals are achieved.
- Annual review of the institutional controls and certification that the controls should remain in place or be modified to reflect changing site conditions.

For evaluation, a conceptual groundwater recovery system for Site 15 would include:

- One recovery well installed through the top 20 feet of the surficial aquifer immediately downgradient of each plume. The wells would have an estimated pumping rate of 30 gpm.
- Both wells designed per site-specific hydrogeology (i.e., filter packs and screen sizes would he determined using site-specific grain-size analyses and projected recovery rates).
- Both wells **equipped** with pumps that could extract between 20 and *50* gpm. Head requirements would be determined during remedial design.
- Both wells equipped with controls and telemetry in the maintenance complex.
- Discharge piping directly to the FOTW sewer system.

The groundwater area to be recovered by the single recovery well during one year would be 200 to 300 feet wide and 400 to 450 feet long, or approximately 120,000 square feet. Assuming a screened interval of 20 feet and a porosity of 0.35, the pore volume recovered by one well in one year would be 6.3 million gallons. Two wells will be operating at separate locations, so the total volume recovered during one year would be roughly 12.5 million gallons. An aquifer test would be performed during the design phase to verify flow rates and capture zones.

Typically, groundwater recovery systems are designed to remove multiple pore volumes from impacted areas. To estimate costs, it is assumed that removal of one pore volume per year would be required. For five-years operation, 62.5 million gallons of groundwater would be removed from impacted areas.

In this alternative, monitoring would include sampling the 18 monitoring wells and two proposed recovery wells for arsenic annually for 30 years. Five QA/QC samples would be collected in each sampling event to ensure analysis quality. The analytical data would be collected and reported along with theoretical modeling results depicting the contaminant plume's changes.

7.2.4 Alternative 4: Groundwater Recovery and Ex-Situ Treatment

This alternative would include the same components as Alternative 3, plus construction of a ex-situ treatment facility using coagulation/precipitation and solids separation (Alternative 4a) or ion exchange (Alternative 4b). Costs presented for each alternative are considered maximum case scenarios.

Alternative 4a: Coagulation/Precipitation and Solids Separation

Capital Cost:	$1,295,800
O&M (Present Worth 5 years)	$2.571, 100
Total Cost:	$3,867,000

This alternative uses physical-chemical coagulation/precipitation and solids separation to remove arsenic from extracted groundwater. This process requires that extracted groundwater pass through two or more tanks where pH is adjusted, coagulation chemicals are added and mixed, and arsenic is precipitated in a sludge. The sludge generated by this treatment technology would need to be filter pressed to increase solid contents and remove excess fluid+ The sludge generated by this **process** would be tested and placed in a Subtitle C or D landfill.

Alternative 4b: Ion Exchange

Capital Cost:	$1,295,800
O&M (Present Worth 5 years)	$2,305,500
Total Cost:	$3,105,000

This alternative uses physical-chemical ionic exchange to filter arsenic from extracted groundwater as it passes through ion-exchange chambers, exchanging counter-ions (i.e., ions of opposite charge) for the arsenic. **As** exchange material used in ion exchange is exhausted, additional counter-ions are applied. The ion-exchange process produces a liquid waste (treated water) that must be discharged to the FOTW.

7.3 Soil Alternatives

7.3.1 Alternative 1: No action

The cost for **Alternative** 1, presented below, is considered the maximum case scenario.

Capital Cost:	$ 0.00
O&M:	$24,400
Total Cost:	$24,400

During the development and evaluation of alternatives, USEPA guidance requires that a no-action alternative be considered as a baseline against which all other alternatives will be evaluated. In the no-action alternative, no remedial actions would be **taken** to contain, remove, or treat soil contamination that exceeds risk-based cleanup goals. Soil would remain in place to attenuate according to natural biotic or abiotic processes.

Since this alternative leaves contamination onsite above acceptable risk based levels, the NCP requires a review of site conditions every five years for a total of 30 years.

7.3.2 Alternative 2: Institutional Controls

The cost for Alternative 2, presented below, is considered the maximum case scenario.

Capital Cost:	$50,000
O&M Cost:	$24,400
Total Cost:	$74,400

This alternative would include:

- Institutional controls imposed in accordance with the LUCAP to restrict access to contaminated soil.

- A five-year review of the institutional controls and certification that the controls should remain in **place** or be modified to reflect changing site conditions.

This alternative would not provide any additional effectiveness for the current-use scenario, but would provide long-term effectiveness by restricting future use and access. Current and future site workers would be **exposed** to soil which presents risks greater than 1E-6 during activities in which they contact surface soil. This alternative would not reduce contaminant toxicity, mobility, or volume. No risks would be posed during short-term implementation.

7.3.3 Alternative 3: Limited Excavation to Industrial Scenario and Offsite Disposal

The cost for Alternative 3, presented below, is considered the maximum case scenario.

Capital Cost:	$230,000
O&M Costs:	$ 0.00
Total Cost:	$230,000

This alternative includes:

- Excavation and offsite disposal of 580 cubic yards (yd^3) of soils presenting risks greater than 1E-6 to a current or future site worker.

- Implementation of institutional controls in accordance with the LUCAP restricting site use to industrial.

- A five-year review of the institutional controls and certification that the controls should remain in place or be modified to reflect changing site conditions.

This alternative would remove soils presenting risk to current and future site workers and control access and site use through institutional controls. Short-term risks due to ingestion, inhalation, and contact would be present to construction workers who are performing the removal; however, these risks can be minimized through proper use of engineering controls and personal protective equipment. The public will be adequately protected during the removal of contaminated soils by following the U.S. Department of Transportation regulations and requirements during transport of contaminated soils to the final disposal facility. It is anticipated that the soil will be disposed of at a RCRA Subtitle D sanitary landfill because soil concentrations are less than 100 mg/kg.

7.3.4 Alternative 4: Asphalt Cover with Institutional Controls and Limited Excavation

The cost for Alternative 4, presented below, is considered the maximum case scenario,

Capital Cost:	***$264***,900
O&M Cost:	$ 67,400
Total Cost	$332,300

This alternative would include:

- Installation of a 4- to 8-inch asphalt cover over contaminated soils to **prevent** exposure to contaminated soil.
- Excavation and offsite disposal of approximately 205 yd^3 of soil which presents risks greater than 1E-6 to current and future site workers.
- **Annual** inspection of the asphalt covers to ensure that the cover is functioning as designed.
- Implementation of institutional controls in accordance with the **LUCAP** to restrict access and site use to industrial.
- A five-year review of the institutional controls and certification that the controls should remain in place or be modified to reflect changing site conditions.

Covers provide reliable protection against dermal contact and ingestion of contaminated soil. They isolate contaminants exceeding risk and guidance concentrations in environmental media, controls would help ensure continued cover effectiveness and regular maintenance would be required. In addition to protecting against existing contamination, the cover drainage system would enhance the current controls for protection against future releases. As operations continue, the drainage system would help prevent additional contamination from releases of herbicides containing arsenic by transporting rinsate and stormwater runoff to the FOTW. These necessary storm water controls would be addressed during cover design. Excavation is effective through removal of contaminated soil exceeding PRGs.

7.4 Applicable or Relevant and Appropriate Requirements

The remedial action for Site 15, under CERCLA Section 121(d), must comply with federal and state environmental laws that are either applicable or relevant and appropriate. Applicable requirements are standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those that, while not applicable, still address problems or situations sufficiently similar to those encountered onsite that their use is well-suited to the particular site. TBC criteria are nonpromulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup for protection of health or the environment.

The affected groundwater in the aquifer beneath Site 15 has been classified by USEPA and FDEP as Class IIA and G-1, a potential source of drinking water. It is Florida and USEPA's policy that groundwater resources be protected and restored to their beneficial uses. A complete definition for USEPA's groundwater classification is provided in the Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy, Final Draft, December 1986. Florida groundwater classifications are defined in Chapter 62-520, Groundwater Classes, Standards, and Exemptions.

While TBCs do not have the status of ARARS, the approach to determining if a remedial action is protective of: human health and the environment involves consideration of TBCs, along with ARARs. Potential ARARs for all of the alternatives are presented in the Site 15 feasibility study.

Chemical-specific ARARs are specific numerical quantity restrictions on individually listed chemicals in specific media. An example of a chemical-specific ARAR would be the MCLs specified under the Safe Drinking Water Act. Since there are usually numerous chemicals of concern for any remedial site, various numerical quantity requirements can be ARARs. Table 7-3 lists chemical-specific ARARs for Site 15's selected remedy.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely on the basis of location. Examples of location-specific ARARs include state and federal requirements to protect floodplains, critical habitats, and wetlands, and solid and hazardous waste facility siting criteria. Table 7-4 summarizes the location-specific ARARs for Site 15's selected remedy.

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities selected to accomplish a remedy. Table 7-5 lists action-specific ARARs and TBCs fur Site 15's selected remedv.

Table 7-3
Chemical-Specific ARARs for the Selected Remedy

Requirements	Status	Requirement Synopsis	Application to the RI/FS
Federal Requirements			
Safe Drinking Water Act MCLs 40 CFR 141.11 - 141.15	Relevant and Appropriate	MCLs have been set for toxic compounds as enforceable standards for public drinking water systems. SMCLs are unenforceable goals regulating the aesthetic quality of drinking water.	The surficial zone of the Sand-and-Gravel-Aquifer is a potential, although unlikely, source of drinking water. Some contaminants in the plume below Site 15 exceed MCLs and SMCLs.
Safe Drinking Water Act MCLGs 40 CFR 141.50-141.51	Relevant and Appropriate	MCLGs are unenforceable goals under the SDWA.	The surficial zone of the Sand-and-Gravel-Aquifer is a potential, although unlikely, source of drinking water. Some contaminants in the plume below Site 15 exceed MCLGs.
State Requirements			
Groundwater Cleanup Target Levels Florida Administrative Code (FAC) 62-785	To Be Considered	Establishes groundwater cleanup goals for Florida	Should be considered when setting remediation objectives. The goals are not currently promulgated.
Soil Cleanup Target Levels Florida Administrative Code (FAC) 62-785	To Be Considered	Establishes soil cleanup limits for Florida	Should be considered when setting remediation objectives. The goals are not currently promulgated.
Drinking Water Standards, Monitoring, and Reporting, FAC 62-550	Applicable	Establishes drinking water standards for drinking water aquifers	The surficial zone of the Sand-and-Gravel-Aquifer is a potential, although unlikely, source of drinking water. Some contaminants in the plume below Site 15 exceed the state MCLs and SMCLs
Ground Water Classes, Standards, and Exemptions, FAC 62-520	Applicable	Establishes groundwater quality standards and classification of groundwater aquifers with the state.	The surficial zone sand-and-gravel aquifer is considered a G-II aquifer (i.e., a potential source of drinking water)

Table 7-4
Location-Specific ARARs for Selected Remedy

Requirements	Status	Requirement Synopsis	Application to the RI/FS
Federal Requirements			
Executive Order 11988 Floodplain Management Policy	To Be Considered	Establishes guidelines for activities conducted within a 100-year floodplain.	Site 15 is located within a 100-year floodplain.
Procedures for Implementing the Requirements of the National Environmental Policy Act 40 CFR Part 6, Appendix A	Applicable	Sets forth EPA policy carrying out the provisions of Executive Order 11988, Floodplain Management Policy, and Executive Order 11990, Wetlands Protection Policy.	Site 15 is located within a 100-year floodplain. Remediation activities may disturb these areas.

Table 7-5
Action-Specific ARARs for the Selected Remedy

Requirements	Status	Requirement Synopsis	Application to the RI/FS
State Requirements			
Florida Storm water Discharge Regulations Title 62 Chapter 62-25	Applicable	Establishes design and performance standards and permit requirements for storm water discharge facilities.	Remedial actions may impact stormwater discharge patterns at Site 15.
Florida Water Well Permitting and Construction Title 62 Chapter 62-532	Applicable	Establishes local criteria for design and installation of monitoring wells.	Installation of monitoring wells may be a necessary part of site remediation given any alternative.

8.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the ROD provides the basis for determining which alternative provides the best balance with respect to the statutory balancing criteria in Section 121 of CERCLA, 42 U.S.C. Section 9621, and in the NCP, 40 CFR, Section 300.430. The major objective of the FS was to develop, screen, and evaluate alternatives for remediating Site 15. Alternatives and technologies were identified as potential candidates to remediate the contamination at Site 15. Their screening was based on their feasibility with respect to the contaminants present and site characteristics. After the initial screening, the remaining alternatives/technologies were combined into potential remedial alternatives and evaluated in detail. The remedial alternative was selected from the screening process using the following nine evaluation criteria:

- Overall protection of human health and the environment.
- Compliance with applicable and/or relevant federal or state public health or environmental standards.
- Long-term effectiveness and permanence.
- Reduction of **toxicity,** mobility, or volume of hazardous substances or contaminants.
- Short-term effectiveness or the impacts a remedy might have on the community, workers, or the environment during implementation.
- Implementability, that is, the administrative or technical capacity to carry out the alternative.

- Cost-effectiveness, considering costs for construction, operation, and maintenance of the alternative over the life of the project, including additional costs, should it fail.

- Acceptance by the state.

- Acceptance by the community.

The NCP categorizes the nine criteria into three groups:

- *Threshold* Criteria – Overall protection of human health and the environment and compliance with ARARs (or invoking a waiver) are threshold criteria that must be satisfied for an alternative to be eligible for selection.

- *Primary* Balancing Criteria – Long-term effectiveness and permanence; reduction of toxicity, mobility or volume; short-term effectiveness; implementability, and cost are primary balancing factors used to weigh major trade-offs among alternative hazardous waste management strategies.

- *Modifying* Criteria – State and community acceptance are modifying criteria that are formally taken into account after public comments are received on the proposed plan and incorporated into the ROD.

The selected alternative must meet the threshold criteria and comply with all ARARs or be granted a waiver for compliance with ARARs. Any alternative that does not satisfy both of these requirements is not eligible for selection. The Primary Balancing Criteria are the technical criteria upon which the detailed analysis of alternatives is primarily based. The final two criteria, known as Modifying Criteria, assess the acceptance of the alternative.

The following analysis summarizes the evaluation of alternatives for remediating OU 4 under each of the criteria. Each alternative is compared for achievement of a specific criterion.

8.1 Evaluation of Groundwater Alternatives

The threshold, primary balancing, and modifying criteria are summarized here for the groundwater alternatives presented in the FS.

8.1.1 Threshold Criteria

All alternatives considered for selection must comply with the threshold criteria, overall protection of human health and the environment, and compliance with ARARs.

8.1.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates the degree of overall protectiveness afforded to human health and the environment. It assesses each alternative's overall adequacy.

The no-action alternative does not reduce, treat, or contain chemical concentrations in groundwater beneath Site 15 and does not prevent use of this water as a potable source. Therefore, this alternative is not considered protective of human health and the environment.

Under an industrial scenario, Alternative 2 addresses long-term effectiveness and permanence by preventing exposure to the contaminant source. Protection of human health is accomplished by placing restrictions on groundwater use and elimination of the ingestion pathway through institutional controls in the LUCAP. No short-term impacts would be associated with this alternative. No threats to Bayou Grande and the tidal pond have been identified and ongoing monitoring would verify protection of the two bodies of water and the environment.

Alternatives 3 and 4 protect human health by containing contaminated groundwater in which arsenic exceeds FPDWS, thus preventing migration of contaminants beyond the source area and effecting mass removal in contaminated zones. Extracted groundwater would be discharged tu the FOTW and treated and discharged under the FOTW's permit. Institutional controls (the LUCAP) would prohibit use of groundwater, thereby, eliminating the ingestion pathway. Through hydraulic containment of the contaminant plume, further migration of contaminated groundwater to Bayou Grande or the tidal pond would be eliminated.

8.1.1.2 Compliance with ARARs

The no-action alternative dues not comply with the RGs developed in Section 7.1.1 of this report; risk goals are ARARs under CERCLA. Nu location- or action-specific ARARs are triggered by the no-action alternative. Contaminated groundwater concentrations would continue to exceed the FPDWS.

Alternative 2 is intended to comply with chemical-specific groundwater ARARs. It is not known at this time if groundwater would reach RGs. Arsenic concentrations would continue to exceed FPDWS in **the** central portion of the site. Modeling and groundwater sampling are intended to document contarninant migration over time. Even though the FPDWS would be exceeded, MCLs are only intended for potable water sources and based on future land-use restrictions, and Site 15 surficial groundwater is not **expected** to be a potable water source. No location or action-specific ARARs would be triggered by groundwater Alternative 2.

Alternative 3 and 4, including groundwater recovery and discharge via the FOTW, comply with the chemical-specific ARARs developed in Section 7.1.1. The contaminated groundwater would be captured by extraction wells, thereby removing groundwater in which arsenic exceeds FPDWS. Removal of groundwater from Site 15 is intended to reduce contaminant mass in the aquifer and contain the two contaminant plumes. The FOTW is subject to NPDES requirements and FOTW effluent discharges must meet permit requirements.

Alternatives 4a and 4b must also comply with waste disposal standards fur waste generated from the filtration system; specific waste disposal ARARs depend on sludge characteristics. Both federal and Florida action-specific ARARs would be met by Alternative 4. Hazardous materials may be treated or stored onsite as a result of remedial activity and proper management of these materials in accordance with Florida Hazardous Waste Rules would be required.

8.1.2 Primary Balancing Criteria

8.1.2.1 Long-Term Effectiveness and Permanence

Alternatives 2, 3, and 4 would provide long-term effectiveness and permanence.

Alternative 2 eliminates residual risk to site workers by eliminating the groundwater ingestion pathway; Site 15 will be designated as an industrial area and groundwater restrictions will be implemented. Groundwater will be monitored to ensure site contaminants do not migrate offsite above performance standards.

Alternative 3 eliminates residual risk by mass removal from the aquifer. In doing so, the plume is contained and contaminant concentrations are reduced below performance standards. Groundwater monitoring would document the reduction of concentrations to below performance standards and ensure that they remain there after the system is shut down.

Alternative 4 eliminates residual risk by removing mass from the aquifer and also treats the water to remove arsenic concentrations above performance standards. In doing so, the plume is contained and contaminant concentrations are reduced to below performance standards.

Groundwater monitoring would document the reduction of concentrations to below performance standards and ensure that they remain after the system is shut down.

8.1.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1, No-Action, and Alternative 2, Monitored Natural Processes/Institutional Controls, would not reduce the groundwater contaminant's mobility or volume; however, toxicity would be slowly reduced by natural processes.

Alternative 3 would reduce toxicity and volume of contaminated site groundwater through removing mass, which would also hydraulically contain the plumes, reducing offsite mobility. No pretreatment of water from the discharge is assumed; however, the discharge would be to the FOTW which would treat the water to meet its NPDES permit.

Alternative 4 would reduce toxicity and volume of contaminated site groundwater through removing mass and would control contaminant mobility through .hydraulic containment. However, this alternative assumes that pretreatment of groundwater is required prior tu discharge to the FOTW. This alternative would reduce the volume of site groundwater contaminants through physical/chemical separation, using either coagulation/precipitation and solids separation or ionic exchange. This alternative reduces toxicity, mobility, and volume through treatment, and satisfies the statutory preference for treatment as a principal element.

8.1.2.3 Short-Term Effectiveness

There are no short-term effects related to the No-Action or Monitored Natural Processed Institutional Controls alternatives, because there is no exposure to groundwater. However, the second alternative is more effective because it restricts groundwater use and site workers are educated of the potential hazards. Site workers collecting groundwater samples for monitoring, will be trained pursuant to 29 CFR 1910.120 and will use proper personal protective equipment (PPE) to minimize exposures.

Alternative 3 should not impact the surrounding environment, Approval from the FOTW to discharge to its system would be required prior to system design. All workers involved in construction and O&M of the system should be trained in accordance with 29 CFR 1910,120 and use appropriate PPE to minimize exposure.

Alternative 4 is similar to Alternative 3, except that sludges from the processes would need to be handled and disposed. Depending on the sludge characteristics, workers may be required to handle hazardous wastes, but workers could be protected with appropriate training and PPE.

8.1.2.4 Implementability

The No-Action alternative is technically feasible and easily implemented.

Monitored Natural Processes/Institutional Controls (e.g., natural attenuation) is technically feasible and easily implemented. Monitoring can be performed easily using the existing monitoring wells; however, two additional monitoring wells are recommended fur modeling. Access to the site has historically been well controlled through the military and access is limited to personnel only. Additionally, groundwater is not used for a potable or industrial use; however, restriction of groundwater use at Site 15 through the LUCAP would be required to ensure it is never used for a potable or industrial use.

Alternative 3, which includes extracting contaminated groundwater from the surficial aquifer beneath Site 15, is not technically or administratively feasible. This has been modified from the Final FS, because new information has been provided by the FOTW indicating that they could not accept groundwater from the site without pretreatment. Groundwater extraction systems with pretreatment technologies are presented as alternatives 4a and 4b.

As with Alternative 3, extraction of contaminated groundwater associated with Alternative 4 is technically and administratively feasible. Construction and operation of the ex-situ treatment units are also technically and administratively feasible and would not require any extraordinary services, materials, specialists, or innovative technologies.

8.1.2.5 Cost

The costs for the five groundwater alternatives, below in Table 8-1, are considered maximum case scenarios (i.e., if Alternative 2 reaches remedial goals in 20 years rather than 30 years, the alternatives total present worth is $540,000 rather than $740,000.). Because of improved housekeeping in the site area, the time to achieve cleanup goals is expected to shorten.

Table 8-1
Groundwater Alternatives Cost Comparison

Cost Element	Alternative: 1	2	3 *	4a w/ Subtitle D	4a w/ Subtitle C	4b
Capital	None	$103,000	$98,000	$1,296,000	$1,296,000	$799,000
Annual O&M	$10,000 (every 5 years)	$39,000 (30 years annually)	$84,300 (for 5 years)	$600,300 (for 5 years)	$610,500 (for 5 years)	$547,340 (for 5 years)
Net Present Worth	$24,400	$740,000	$603,000	$3,824,000	$3,867,000	$3,105,000

Note:
* = Alternative 3 can not be implemented because discharge to the FOTW cannot occur without pretreatment of the flow. Alternatives with pretreatment include Alternatives 4a and 4b.

8.1.3 Modifying Criteria

8.1.3.1 State/Support Agency Acceptance

The State of Florida agrees with the selection of Alternative 2 to remediate Site 15.

8.1.3.2 Community Acceptance

To be completed after the public-comment period.

8.2 Evaluation of Soil Alternatives

The threshold, primary balancing, and modifying criteria are summarized here for the groundwater alternatives presented in the FS.

8.2.1 Threshold Criteria

All alternatives considered **for** selection must comply with the threshold criteria, overall protection of human health and the environment, and compliance with ARARs.

8.2.1.1 Overall Protection of Human Health and the Environment

The No-action alternative provides no additional protection to human health or the environment and would leave soil exceeding Arsenic's RG at **24** locations.

Alternative **2,** institutional controls, provides additional protection of human health and the environment by reducing the potential for ingestion or contact with soil through institutional controls. However, soil arsenic concentrations at Site 15 exceed RGs. Under the institutional controls scenario, this soil would remain, but risks would be reduced by elimination of dermal contact and ingestion pathways that are present with uncontrolled access.

Alternative 3, Limited Excavation to Industrial Scenario and Offsite Disposal, protects human health and the environment by removing contaminated soil exceeding RGs. Risk to human health and the environment from contaminants exceeding the FDEP SCTL industrial threshold would be eliminated. The minimal short-term risks from inhalation and dermal contact during implementation could be controlled using common engineering techniques and use of PPE.

Alternative 4, the Asphalt Cover with Institutional Controls and Limited Excavation, would eliminate the threat of dermal and ingestive contact for current and future site workers. Contaminated soil would be left onsite indefinitely and the cover would be maintained to ensure adequate protection. Excavation and offsite disposal protects human health and the environment by removing contaminated soil. This alternative would protect human health and the environment by physically eliminating receptor pathways and controlling access through land-use restrictions. Cover construction and maintenance would be easily implemented and current site controls (site security, access control, and fencing) and the LUCAP would be adequate to ensure minimal disturbance of onsite covers. The minimal short-term risks from inhalation and dermal contact during implementation could be controlled using common engineering techniques and use of PPE.

8.2.1.2 Compliance with ARARs

Alternatives 1 and *2* do not comply with the risk goals developed in Section 2 of this report; risk goals are ARARs under CERCLA. No location- or action-specific ARARs are triggered by the no-action alternative. Contaminated soil that exceeds RGs would remain.

Alternative 3 would meet chemical-specific ARARs for the associated RGs that protect future industrial site workers. No location-specific ARARs would be triggered by this alternative.

Alternative 4, asphalt cover with institutional controls and limited excavation, would comply with the chemical-specific ARAR proposed as an RG for future industrial workers to protect human health. The potential for contact with soil in which contaminants exceed the FDEP SCTL industrial threshold is eliminated by removing the primary pathways and sources. In addition, the cover would isolate or eliminate contaminants exceeding RGs in environmental media. Site grading would need to comply with federal, state, and local air emissions and storm water control regulations. The asphalt cover and limited excavation would not trigger any location-specific ARARs.

8.2.2 Balancing Criteria

8.2.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness of no-action is minimal. Soil volumes and concentrations would remain unchanged and the magnitude of residual risk would remain. This alternative lacks treatment actions that provide permanence. Any controls currently in place at the site – military security and limited access to the site and use of it – would remain. If use were unrestricted, no controls would be in place to protect potential receptor groups (i.e., residents).

The long-term effectiveness of Alternative 2, institutional controls, is limited to controlling access to contaminated soil. The volume and concentrations of soil would remain unchanged. This alternative lacks treatment actions that would provide permanence.

Alternative 3, excavation and offsite disposal, would remove the contaminated soil from the site and dispose of it in a permitted Subtitle D disposal facility. This alternative would eliminate risk from contaminants exceeding the FDEP SCTL industrial threshold. Soil remaining onsite would not threaten human health. Excavation with offsite disposal is a particularly reliable option, because soil would be removed from the site and onsite risks exceeding RGs would be eliminated. However, future liability might be incurred through disposal at a landfill.

Alternative 4's asphalt cover would effectively reduce site worker dermal or ingestive contact with contaminated soil. It would require observation and maintenance; soil covers are generally reliable containment controls. If the soil cover failed, site workers could be exposed; however, repairs could be made to re-establish the cover's integrity. Excavation would remove contaminated soil and eliminate risk exceeding the FDEP SCTL industrial threshold. This alternative eliminates residual risk to site workers by managing Site 15 as an industrial site and restricting land use. The use of these covered soil areas would be controlled institutionally. Excavation eliminates risk through contaminated source removal. Some future liability might be incurred through disposal at a landfill.

8.2.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

The No-action and the Institutional Control alternative would not reduce soil contaminant mobility, toxicity, or volume.

Alternative 3, excavation with offsite disposal, would not satisfy this preference for treatment. It is anticipated that excavated soil is nonhazardous; however, TCLP analysis would be performed for verification. Excavation would eliminate the source area and therefore, eliminate contaminants exceeding RGs. This alternative includes the removal of approximately 580 yd^3 of soil from the site, which would be isolated in a secure landfill. Because the source would no longer remain onsite, excavation is considered permanent. Mobility, toxicity, and volume would not be reduced and the preference for treatment would not be satisfied.

Constructing an asphalt cover at Site 15, as discussed in Alternative 4, would not remove, treat, or remediate the contaminated soil; it provides containment only. Excavation would remove contaminated soil but would not provide treatment. The asphalt cover is considered reversible because contaminants exceeding RGs under the asphalt cover would remain onsite; if the cover fails because of poor maintenance, contaminants may be exposed. Excavation is considered permanent since the source does not remain onsite. This alternative would not reduce toxicity, mobility, or volume through treatment, nor would it satisfy the statutory preference for treatment.

8.2.2.3 Short-Term Effectiveness

Short-term effectiveness assesses an alternative's effect on human health and the environment while it is being implemented. There are no short-term effects resulting from the no-action or institutional controls alternatives.

Alternative 3's excavation would be sufficiently removed from the public to reduce health and safety concerns associated with soil removal. Excavation workers would be exposed to increased particulate emissions and might also have more dermal contact with hazardous constituents. However, worker risks can be reduced by implementing dust control technologies and a site-specific health and safety plan that specifies PPE, respiratory protection, etc.

Adverse impacts to the surrounding environment are not anticipated during cover construction as part of Alternative 4; engineering controls would be applied to manage storm water runoff and siltation. Once design plans are approved, actual cover construction would be expected tu take less than one month. During construction of the two covers, there would be a risk of dermal or ingestive contact to construction workers; however, this risk would be reduced by proper removal practices and use of PPE. During excavation, workers would be exposed to increased particulate emissions and might have more dermal contact with hazardous constituents. However, worker risks can be controlled through the use of dust control technologies and PPE.

8.2.2.4 Implementability

The no-action and institutional control alternatives are technically feasible and easily implemented. Excavation with offsite disposal associated with Alternative 3 is technically and administratively feasible at Site 15. Removal and offsite disposal have been commonly applied at previous sites. The only potential technical problems that might slow down removal activities are materials handling and disposal (standby time between confirmatory sampling and disposal). The soil volumes are relatively small (*580* yd^3) and removal activities are anticipated to be easily given that the proposed areas to be covered or excavated are easily accessible to site workers and current access controls have been reliable and will be supplemented through the LUCAP. Thus, implementing this alternative would merely involve placement of the cover, implementation of the LUCAP, and excavation and soil removal. Future monitoring and maintenance would involve visually inspecting the cover periodically and repairing any damage or degradation. However, repairs are easily implemented. Soil covering would not require any extraordinary services or materials. Offsite disposal would be required for excavated soil.

8.2.2.5 Cost

The costs for the four soil alternatives, below in Table 8-2, are considered maximum case Scenarios.

Table 8-2
Soil Alternatives Cost Comparison

Cost Element	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Capital	**None**	**$50,000**	**$230,000**	**$264,800**
Annual O&M	$10,000 (every 5 years)	$10,000 (every 5 years)	None	$4,900 (every year for 30 years)
Net Present Worth	**$24,400**	$74,400	**$230,000**	**$332,300**

8.2.3 Modifying Criteria

8.2.3.1 State/Support Agency Acceptance

The State of Florida agrees with the selection of Alternative 3 to remediate Site 15.

8.2.3.2 Community Acceptance

To be completed after the public-comment period.

9.0 THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, the Navy has selected Alternative S-3 (Excavation with Offsite Disposal) for soii and Alternative *G-2* (Monitored Natural Attenuation/Institutional Controls) for groundwater as the remedial actions for OU 4. At the completion of this remedy, the risk associated with this site will be protective of human health and the environment.

The selected alternative for OU 4 is consistent with the requirements of Section 121 of CERCLA and the NCP. The selected alternative will reduce the mobility, toxicity, and volume of contaminated soil and groundwater onsite. In addition, the selected alternative is protective of human health and the environment, will attain all federal and state ARARs, is cost-effective, and uses permanent solutions to the maximum extent practicable.

Based on the information available at this time, the selected alternative represents the best balance among the criteria used to evaluate remedies. Alternatives S-3 and G-2 are thought to be protective of human health and the environment, will attain ARARs, will be cost-effective, and will use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

9.1 Source Control

Since **the** Baseline Risk Assessment indicates unacceptable risk from exposure to soil, source control remediation will address removing contaminated soil above the industrial goals (i.e., ILCR of $1x10^{-6}$) at the site and monitoring natural attenuation of groundwater. The soil industrial goal of 1x10-6 was selected by the Navy, in conjunction with USEPA and FDEP consultation, as a conservative estimate protective of potential human receptors and future uses of the property. Source control shall include institutional controls to be placed in accordance with the LUCAP as agreed by the **USEPA,** FDEP, and the Navy.

The major components of source control to be implemented include:

- Excavation and removal of soil posing a risk greater than 1x10-6.

- Institutional controls imposed in accordance with the LUCAP to restrict groundwater use of the surficial zone of the Sand-and-Gravel **Aquifer** within 300 feet of the site.

- Annual review of the institutional controls and certification that they should remain in place or be modified to reflect changing site conditions.

9.2 Monitoring

Groundwater monitoring will be implemented at OU 4 to ensure that contaminated groundwater is not migrating offsite. The major components of groundwater monitoring to be implemented are:

- Placement of institutional controls to preclude usage of groundwater in the surficial zone of the Sand-and-Gravel Aquifer within 300 feet of the site

- Implementation of a groundwater monitoring program? in accordance with the Groundwater Monitoring Plan, to monitor compliance with the performance standards listed in Table 9-1.

Table 9-1
Performance Standards for Groundwater

Contaminant	Performance Standards (ppb)
Arsenic	50

Notes:
Performance standard is Florida's Primary Drinking Water Standard **FAC** *62-550.*
The standard is in micrograms per liter (μg/L) or parts per billion **(ppb).**

9.3 Compliance Testing

Groundwater will be monitored at this site in accordance with the monitoring plan to be completed during the remedial design. After continued attainment of the performance standards for two consecutive sampling events and concurrence from USEPA and the State of Florida the monitoring program may be discontinued.

10.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, 42 U.S.C. § 9621, the Navy must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume? toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy at OU **4** meets these statutory requirements.

10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment by eliminating, reducing, and controlling risk through soil removal, institutional controls and monitoring through performance standards described in Section 9. Contaminated groundwater will be monitored to meet the performance standards described in Section 9. Institutional controls will prevent exposure to contaminants in groundwater. The review will ensure that the performance standards are being met. Monitoring will ensure that contaminated groundwater is not discharging to the nearby surface water bodies.

10.2 Attainment of the ARARs

Remedial actions performed under CERCLA, Section 121, 42 U.S.C. § 9621 must comply with all ARARs. **All** alternatives considered for OU 4 were evaluated based on the degree to which they complied with these requirements. The selected remedial action was found to meet or exceed identified ARARs.

The selected remedy was found to meet or exceed ARARs identified in Tables 7-3, 7-4, and 7-5. The following is a short narrative in support of attainment of the pertinent **ARARs.**

Chemical-Specific ARARs

Groundwater restoration performance standards identified as MCLs are the groundwater protection standards set out in this ROD as performance standards for remedial. action. Performance standards are consistent with ARARs identified in Table 7-3.

Location-Specific ARARs

Performance standards are consistent with ARARs identified in Table 7-4.

Action-Specific ARARs

Performance standards are consistent with ARARs identified in Table 7-5; these regulations will be incorporated into the design and implementation of this remedy.

Waivers

Section 121 (d)(4)(C) of CERCLA, 42 U.S.C. § 9621(d)(4)(c) provides that an ARAR may be waived when compliance with an **ARAR** is technically impracticable from an engineering perspective.

Other Guidance To Be Considered

Other guidance TBCs include health-based advisories and guidance. TBCs have been used in estimating; incremental cancer risk numbers for remedial activities at the sites and in determining RCRA applications to contaminated media. TBCs for OU 4 include *Guidelines for Groundwater Classification* under the **EPA** Groundwater *Protection* Strategy. Draft Final, December 1986.

10.3 Cost-Effectiveness

The Navy believes the selected remedy. Alternatives S-3 and G-2, will eliminate risks to human health at an estimated cost of $970,000. Alternatives S-3 and G-2 are expected to achieve a comparable effectiveness at a substantially lower cost than the other alternatives (although over a longer time). Alternatives S-3 and G-2 provide an overall effectiveness proportionate tu its costs, such that it represents a reasonable value achieved for the investment.

10.4 Use of Permanent Solutions to the Maximum Extent Practicable

The Navy, with USEPA and FDEP concurrence, has determined that the selected remedy represents the maximum **extent** to which permanent solutions and treatment technologies can be used cost-effectively fur final remediation at OU 4 at NAS Pensacola. Of those alternatives that protect human health and the environment and comply with ARARs, the Navy, with **USEPA** and FDEP concurrence, has determined that this selected remedy provides the best balance of trade-offs in long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness; implementability; and cost, while also considering the statutory preference for treatment as a principal element and consideration of state and community acceptance. The selected remedy provides for long-term effectiveness and permanence; is easily implemented; reduces toxicity, mobility, or volume, and is cost-effective.

10.5 Preference for Treatment as a Principal Element

Because soil treatment is practicable, the statutory preference for remedies that employ treatment as a principal element is satisfied. In groundwater, the statutory preference for treatment is directly linked to the balancing criteria for a reduction in toxicity, mobility, and volume of contarnination. Given that source control measures will or have been executed and the soil removal, a continued decrease of groundwater contamination is the probable result of the natural attenuation base of action. Therefore, the statutory preference for treatment as a principal element is satisfied.

11.0 DOCUMENTATION OF NO SIGNIFICANT CHANGES

This section will be completed after the public-comment period.

12.0 REFERENCES

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Appendix A

Glossary

GLOSSARY

This glossary defines terms used in this record of decision describing CERCLA activities. The definitions apply specifically to this record of decision and may have other meanings when used in different circumstances.

ADMINISTRATIVE RECORD: A file that contains all information used by the lead agency to make its decision in selecting a response action under CERCLA. This file is to be available for public review and a copy is to be established at or near the site, usually at one of the information repositories. Also a duplicate is filed in a central location, such as a regional or state office.

AQUIFER: An underground formation of materials such as sand, soil, or gravel that can store and supply groundwater to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

BASELINE RISK ASSESSMENT: A study conducted as a supplement to a remedial investigation to determine the nature and extent of contamination at a Superfund site and the risks posed to public health and/or the environment.

CARCINOGEN: A substance that can cause cancer.

CLEANUP: Actions taken to deal with a release or threatened release of hazardous substances that could affect public health and/or the environment. The noun "cleanup" is often used broadly to describe various response actions or phases of remedial responses, such as Remedial Investigation/Feasibility Study.

COMMENT PERIOD: A time during which the public can review and comment on various documents and actions taken, either by the Department of Defense installation or the USEPA. For example, a comment period is provided when USEPA proposes to add sites to the National Priorities List,

COMMUNITY RELATIONS: USEPA's, and subsequently Naval Air Station Pensacola's, **program** to inform **and** involve the public in the Superfund process **and** respond to community concerns.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act **(SARA).** The act created a special tax that goes into a trust fund, commonly known as "Superfund," to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Under the program the **USEPA** can either:

- Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work.

- Take legal action to force parties responsible for site contamination to clean **up** the site or pay back the federal government for the cost of the cleanup.

DEFENSE ENVIRONMENTAL RESTORATION ACCOUNT (DERA): An account established by Congress to fund Department of Defense hazardous waste site cleanups, building demolition, and hazardous waste minimization. The account was established under the Superfund Amendments and Reauthorization Act.

DRINKING WATER STANDARDS: Standards for quality of drinking water that **are** set by both the **USEPA** and the FDEP.

EXPLANATION OF DIFFERENCES: **After** adoption of final remedial action plan, if any remedial or enforcement action is taken, or if any settlement or consent decree is entered into, and if the settlement or decree differs significantly from the final plan, the lead agency is required to publish an explanation of any significant differences and why they were made.

FEASIBILJTY STUDY: See Remedial Investigation/Feasibility Study.

GROUNDWATER: Water beneath the earth's surface that fills pores between materials such as sand, soil or gravel. **In aquifers,** groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

HAZARD RANKING SYSTEM (HRS): A scoring system used to evaluate relative risks to public health and the environment from releases or threatened releases of hazardous substances. USEPA and states use the HRS to calculate a site score, from 0 to 100, based on the actual or potential release of hazardous substances from a site through air, surface water, or groundwater to affect **people.** This score is the primary factor used tu decide if a hazardous site should be placed on the NPL.

HAZARDOUS SUBSTANCES: Any material that poses a threat to public health and/or the environment. **Typical** hazardous substances are materials that are **toxic**, corrosive, ignitable, explosive, or chemically reactive.

INFORMATION REPOSITORY: A file containing information, technical reports, and reference documents regarding a Superfund site. Information repositories for Naval **Air** Station Pensacola are at The John C. Pace Library at the University of West Florida and the **NAS** Pensacola Library in Building 633 on the Naval **Air** Station, Pensacola, Florida.

MAXIMUM CONTAMINANT LEVEL: National standards for acceptable concentrations of contaminants in drinking **water.** These standards are legally enforceable standards set by the **USEPA** under the Safe Drinking Water **Act.**

MONITORING WELLS: Wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to assess the groundwater flow direction and the types and amounts of contaminants present, etc.

NATIONAL PRIORITIES LIST (NPL): The USEPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified **for** possible long-term remedial **response** using money from the trust fund. The list is based primarily on the score a site receives on the Hazard Ranking System. USEPA is **required** to update the NPL at least once **a** year.

PARTS PER BILLION (ppb)/PARTS PER MILLION (ppm): Units commonly used to **express** low concentrations of Contaminants. For example, 1 ounce of trichloroethylene in a million ounces of water is 1 ppm; 1 ounce of trichloroethylene in a billion ounces of water is 1 ppb. If one drop of trichloroethylene is mixed in a competition-size swimming pool, the water will contain about **1 ppb** of trichloroethylene.

PRELIMINARY REMEDIATION GOALS: Screening concentrations that are provided by the **USEPA** and the FDEP and are used in the assessment of the site for comparative purposes before remedial goals being set during the baseline risk assessment.

PROPOSED PLAN: **A** public participation requirement of **SARA** in which the lead agency summarizes for the public the preferred cleanup strategy, and the rationale for the preference, reviews the alternatives presented in the detailed analysis of the remedial investigation/feasibility study, and presents any waivers to cleanup standards of Section 121(d)(4) that may be proposed. This may be prepared either as a fact sheet or as a separate document. In either case, it must actively solicit **public** review and comment on all alternatives under agency consideration.

RECORD OF DECISION (ROD): **A** public document that explains which cleanup alternative(s) will be used at NPL sites. The Record of Decision is based on information and technical analysis generated during **the** remedial investigation/feasibility study and consideration of public comments and community concerns.

REMEDIAL ACTION (RA): The actual construction or implementation phase that follows the remedial design and **the** selected cleanup alternative at a site on the NPL.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS): Investigation and analytical studies usually performed at the same time in an interactive process, and together referred tu as the "RI/FS." They are intended to: (1) gather the data necessary to determine the type and extent of contamination at a Superfund site; (2) establish criteria for cleaning up the site; (3) identify and screen cleanup alternatives for remedial action; and (4) analyze in detail the technology, and costs of the alternatives.

REMEDIAL RESPONSE: A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat tu public health and/or the environment.

REMOVAL ACTION: An immediate action performed quickly to address a release or threatened release of hazardous substances.

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA): A federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent new, uncontrolled hazardous waste sites.

RESPONSE ACTION: As defined by Section 101(25) of CERCLA, means remove, removal, remedy, or remedial action, including enforcement activities related thereto.

RESPONSIVENESS SUMMARY: A summary of oral and written public comments received by the lead agency during a comment period on key documents, and the response to these comments prepared by the lead agency. The responsiveness summary is a key part of the ROD, highlighting community concerns for USEPA decision-makers.

SECONDARY DRINKING WATER STANDARDS: Secondary drinking water regulations are set by the USEPA and the FDEP. These guidelines are not designed to protect public health, instead they are intended to protect "public welfare" by providing guidelines regarding the taste, odor, color, and other aesthetic aspects of drinking water which do no present a health risk.

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conduct clean ups of past hazardous waste disposal sites, and current releases or threats of releases of nonpetroleum products. Superfund is often divided into removal, remedial, and enforcement components.

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enacted on October 17, 1986, to reauthorize the funding provisions, and to amend the authorities and requirements of CERCLA and associated laws. Section 120 of SARA requires that all federal facilities "be subject to and comply with, this act in the same manner and to the same extent as any non-governmental entity."

SURFACE WATER: Bodies of water that are aboveground, such as rivers, lakes, and streams.

VOLATILE ORGANIC COMPOUND: An organic (carbon-containing) compound that evaporates (volatizes) readily at room temperature.

Appendix B

Responsiveness Summary

RESPONSIVENESS SUMMARY

Overview

During the public comment period, the U.S. Navy proposed a preferred remedy to address soil and groundwater Contamination at Operble Unit 4 on NAS Pensacola. This preferred remedy was selected in coordination with the USEPA and the FDEP. The NAS Pensacola Restoration Advisory Board, a group of community volunteers, reviewed the technical details of the selected remedy.

'The sections below describe the background of community involvement on the project and comments received during the public comment period.

Background of Community Involvement

Throughout the site's history, the community has been kept abreast of site activities through press releases to the local newspaper and television stations that reported on site activities. Site-related documents were made available to the public in the administrative record at information repositories maintained at the NAS Pensacola Library and the John C. Pace Library of the University of West Florida.

After finalizing the RI and Feasibility Study (FS) reports, the preferred alternative for Site 15 was presented in the Proposed Remedial Action Plan, also called the Proposed *Plan*. Everyone on the NAS Pensacola mailing list was sent a copy of the proposed plan. The notice of availability of the Proposed Plan, RI, and FS reports was published in the Pensacola *News* Journal on August 21, 1999. A public-comment period was held from August 23 to October 6, 1999, to encourage public participation in the remedy selection. In addition, the opportunity for a public meeting was provided, and was not requested.

A responsiveness summary is required to document how the Navy addressed citizen comments and concerns, raised during the public comment period. All comments summarized in the appendix have been factored into the final decisions of the remedial action for Operable Unit 4 at NAS Pensacola.

Summary of Major Questions and Comments Received During the Public Comment Period and the Navy's Responses

Comment	Response
1. Do the proposed actions for soil and groundwater provide the best tradeoff between safety and costs?	The Navy, in coordinated with USEPA and FDEP, have reviewed the alternatives and their associated costs, The selected preferred alternatives are the most cost effective ways to protect human health and the environment. The baseline risk assessment concluded that there was no unacceptable risk to industrial users of the site after removal of the selected areas. Any excavation work would be monitored to prevent unacceptable exposure. Groundwater use will also be restricted in the OU 4 area to prevent unacceptable risk to industrial users. In addition, groundwater will be monitored to prevent unacceptable risk to ecological resources in Bayou Grande.